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Vol. 83 Washington : 1937 No. 2997

REVIEW OF THE SEAHORSES (HIPPOCAMPUS) FOUND ON THE COASTS OF THE AMERICAN CONTINENTS AND OF EUROPE [1]

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INTRODUCTION

The peculiar little fishes known as seahorses in English-speaking countries, or generally by a translation of that term in other countries, have caught the popular fancy and attracted wide interest since ancient times, because of their bizarre appearance. Recognizable descriptions of seahorses may be traced back to the writings of the ancients.[2] Among the descriptions and even figured representations of aquatic monsters by the old writers, one comes across such circumstantial accounts that it becomes evident that they really believed in the existence of such monsters. In some cases at least they must have had in mind some hazy memory of a seahorse. Even in our sophisticated times the seahorse remains an object of absorbing interest. Specimens are often sold as souvenirs and are sometimes gilded and used as fobs for watch chains or for other ornamental purposes. No less than the popular attraction is the scientific interest in these fishes, because of their peculiar structure, their distinctive mode of life, and their unusual method of reproduction. Their peculiar, bony, jointed external skeleton, the shape of their head, which markedly resembles, in miniature, that of a horse, and their

[1] Published by permission of the United States Commissioner of Fisheries.

[2] For a discussion of old accounts and figures of seahorses, see Eastman, Ann. Rep. Smithsonian Inst. for 1915, pp. 349-357, 4 pls., 1916.

prehensile tail are so unfishlike that it is no wonder some of the early writers suggested their relationship to insects.

Think of a fish that has a prehensile tail and is able to suspend tself, monkeylike, by curling the end of it around the stems or branches of aquatic plants! Its extraordinary method of reproduction is no less remarkable than its peculiar structure. The male develops a large pouchlike organ on the underside of the body. In the process of reproduction the eggs are transferred from the female into the specialized organ of the male, where they are incubated and the young remain for some time after hatching.[3] It seems that when nature created the seahorse it was determined to do a good job and concentrated all sorts of oddities in this little creature. Here is a fish the head of which resembles that of a horse; with a hard-jointed external skeleton resembling that of an insect; with a prehensile tail like a monkey's; and with a pouch on its underside for carrying its young after the fashion of a kangaroo, but the male instead of the female acts as an incubator and carries the young.

Notwithstanding the wide popular and scientific interest that these truly fascinating living things have attracted, it is remarkable, and in a measure symptomatic of the state of taxonomy of fishes in general, how much misapprehension exists in regard to the proper distinction of the separate species, as the data presented here will amply prove. To show the existing chaotic state in the systematics of *Hippocampus*, the genus of seahorses, some of the results of my study may be considered here briefly.

This investigation was undertaken chiefly to evolve satisfactory characters for separating the species found on the Atlantic and Pacific coasts of North and South America and to establish definitely the intraspecific ranges of variation. It was found desirable to include also the species from the coasts of Europe, since they are very closely related to the common American species, and there was some question as to whether they are really distinct. It has also been necessary to establish five new species, which were briefly described in a preliminary paper,[4] and one new subspecies, described herein. Furthermore, five more or less recent names proposed for seahorses from American waters had to be reduced to synonymy. The appropriateness of the synonymic reduction of one or two of these names may be open to question until their types are reexamined, but their authors certainly did not prove the distinctness of the supposedly new species.

A suggestive case of the existing errors in the systematics of *Hippocampus* may be cited here. According to the generally accepted

[3] For a review of the known facts in the biology of the seahorse, see Gill, Proc. U. S. Nat. Mus., vol. 28, pp. 805–814, 1905; and Rauther, Syngnathiden des Golfes von Neapel, 1925.

[4] Journ. Washington Acad. Sci., vol. 23, pp. 560–563, 1933.

"belief", three more or less common and large species exist on the Atlantic coast of the United States, namely, *H. hudsonius*, *H. punctulatus*, and *H. stylifer*, which allegedly may be distinguished largely by the number of rays in the dorsal fin, *hudsonius* having the most rays and *stylifer* the least. It will be shown definitely hereafter that *stylifer* is a fictitious species based originally on a young female of *punctulatus*, while *hudsonius* and *punctulatus* are merely geographical subspecies that intergrade to a high degree; and, moreover, that *hudsonius* is the one averaging the fewest dorsal rays.

The student will find similarly striking cases in the text, but for benefit of readers who do not wish to delve too deeply into the systematics of *Hippocampus*, one more interesting illustration may here be cited. Nearly all authors correctly distinguished two common species of seahorses, *hippocampus* (*brevirostris* of most authors) and *guttulatus*, from the Mediterranean coast of Europe. These two species are readily separable, as is shown hereafter. However, the systematics of the seahorses on the Atlantic coast of Europe are generally muddled. An inclusive, though probably incomplete, review of the literature shows that the consensus of opinion among authors is that only one species of seahorse exists on the Atlantic coast of Europe. This allegedly single species has been referred now to one now to the other of the two common Mediterranean species, depending on the author. This treatment is evidently not in accordance with the facts. My study indicates, if the stated localities of the lots examined are correct, that at least two species of seahorses exist on the Atlantic as well as on the Mediterranean coast of Europe, but the two Atlantic species are not so readily separable as the Mediterranean ones. One of the Atlantic coast species is closely related to but distinct specifically from *hippocampus* and is designated hereafter as *europaeus*. The other Atlantic seahorse is apparently conspecific with *guttulatus* from the Mediterranean, but the Atlantic coast population diverges sufficiently to be regarded as subspecifically distinct from the Mediterranean population, and is designated herein as *multiannularis*. Since, however, part of the European seahorses in American museums that were available for examination are in indifferent condition and the locality records of some of the lots are uncertain, the conclusions regarding the European species arrived at may have to be modified after an examination of larger numbers of specimens in good condition and with definite locality records. However, my study and a review of the literature showed without doubt that the current systematic treatment of the seahorses found on the Atlantic coast of Europe is largely erroneous.

The confusion in the systematics of *Hippocampus* is shown even more strikingly by the obvious and frequent misapplication of names

in published records. This is true not only of sporadic and occasional records, as in local lists of fishes, but also of accounts of the entire genus. Three such accounts have been published, namely, by Kaup,[5] by Duméril,[6] and by Günther.[7] After one becomes familiar with the true distinctive specific characters and the geographical distribution of the species, it is only necessary to skim through the accounts of these authors to see how badly in some cases they mixed up their species.[8]

On account of existing errors it seemed useless, or even misleading in some cases, to attempt a compilation of complete bibliographies of the species concerned to indicate their geographic distribution. Consequently, the bibliographic citations given here under each species include only: (1) Primary synonyms; (2) references having a direct bearing on the nomenclature; (3) readily available records based on material examined by me; and (4) a few records that may be referred to their proper species with some assurance. The precise geographical limits of nearly all the species or subspecies still remain to be determined.

ACKNOWLEDGMENTS

I wish to express grateful acknowledgment for aid rendered in this investigation, which is based largely on the comparatively extensive collection of seahorses in the United States National Museum. Dr. Alexander Wetmore and Dr. Leonhard Stejneger kindly permitted my access to the facilities and collections of the Museum, and Earl D. Reid unstintedly gave his time to make available these collections. Special acknowledgment is due Dr. George S. Myers, who took his post as assistant curator of fishes in the National Museum while this study was in progress. Besides making some constructive suggestions and calling my attention to some obscure publications, Dr. Myers, in putting in order the mass of accumulated miscellaneous unclassified material in the National Museum, uncovered and placed at my disposal many desirable specimens, which

[5] Catalogue of the lophobranchiate fish in the collection of the British Museum, 1856.

[6] Histoire naturelle des poissons ou ichthyologie générale, vol. 2, 1870.

[7] Catalogue of the fishes of the British Museum, vol. 8, 1870.

[8] Such treatment of *Hippocampus* has continued until our day. In a work on the fishes of West Africa by H. W. Fowler (Bull. Amer. Mus. Nat. Hist., vol. 70, 1936), which appeared after the completion of the manuscript of this report, the author makes the statement that he cannot "find any characters worthy of specific distinction" between *H. hudsonius* and *H. hippocampus*, and at the same time he recognizes *H. punctulatus* as a fully distinct species. As a matter of fact, *punctulatus* is nothing more than a geographic subspecies of *hudsonius*, while *hudsonius* and *hippocampus* are as fully distinct and divergent as almost any other two species of the subgenus *Hippocampus*. If those two species were synonymized, it would be necessary, in order to be consistent, to lump all species of the subgenus *Hippocampus* in one species. Such a taxonomic absurdity was not suggested for more than a century by any writer that I know of, and it is evidently not subscribed to by Fowler. His descriptions were apparently made in haste, and it is hard to surmise the species he had; but judged by the dorsal count he gives under *hippocampus*, it seems apparent that his account of that "species", based on Mediterranean material, includes specimens of both common species occurring in the northern part of that sea, *hippocampus* and *guttulatus*. His account of *punctulatus* undoubtedly is also based on material of more than one species, judged by the geographical distribution of the species of *Hippocampus* in general.

aided materially in bringing this study to a point more nearly approaching completeness. For material lent by other institutions acknowledgment is due the following: Dr. Carl L. Hubbs, who lent two lots of seahorses from the Zoology Museum of the University of Michigan, one of these lots forming the basis of a new subspecies, *multiannularis;* Alfred C. Weed, who lent the desirable collection of *Hippocampus* in the Field Museum of Natural History, which helped me considerably in distinguishing *kincaidi* and in confirming my conclusions in regard to some other species and subspecies; John T. Nichols, who lent seven specimens of *H. hippocampus* from the collection of the American Museum of Natural History, which were of considerable help in distinguishing that species from closely related ones.

Particular mention is made of the work of Miss Louella E. Cable, who executed with skill and painstaking care the drawings for the figures, which should prove invaluable in the identification of specimens. Whatever merit this report may prove to have, it will be greatly enhanced by these beautiful and accurate illustrations.

DEFINITIONS AND METHODS OF STUDY [9]

The proper differentiation of the species of *Hippocampus* is difficult at best. This difficulty is greatly increased by the lack of uniformity in descriptions of the species by various authors. It becomes necessary, therefore, to explain the methods of study and define the terms used.

How to determine accurately the number of trunk segments.—The first important point to decide is a uniform method in the determination of the boundary line between the trunk and the tail, since the number of segments in the trunk and to a lesser extent that of the tail form specific characters of primary importance. The distinction between trunk and tail is readily made after the integument is removed and the exoskeleton uncovered (fig. 54). This is, of course, impracticable when identifying specimens. Externally the last trunk segment is readily determined by the fact that the ventrolateral ridge of the trunk extends only to that segment. The last spur on that ridge, or, where the spur is missing, the last intersection of the longitudinal with the transverse ridge on the side, unmistakably marks the last trunk segment. From that intersection a winglike extension converges with its fellow from the other side to the base of the anal for the support of that fin, but this extension is usually covered by thick integument and not visible externally. In practice the best way to count the trunk segments with absolute accuracy is to trace the transverse ridge on the last segment from its lower point, as de-

[9] The reader will find it advantageous to study figure 54 in connection with the discussion here of the structure of some parts of the exoskeleton, which are of importance in classification.

termined above, to the spur under the base of the dorsal fin, and count the spurs or spines on the upper ridge, forward. Where the spurs or spines fade out anteriorly, the transverse ridges on the back of the segments in front of the dorsal fin always saliently mark their segments.

What appears on external examination to be the first trunk segment, the one bearing the pectoral, is a compound segment and is composed of three metameres, corresponding to the first three vertebrae, according to Rauther.[10] The posterior one of these three metameres is readily identified by having a spur on the upper longitudinal ridge and a transverse ridge on the back, as in the following segments. It was consequently included in the counts recorded in this study. The more or less reduced elements of the anterior two metameres are intimately fused with the third, and the three appear externally as a single somewhat irregular segment, bearing the pectoral fin. This compound segment was uniformly counted as one throughout this study, by including the spur or ridge of the third metamere with the following ones, as stated. The anterior two metameres were not included separately in the count, although their presence usually may be detected externally by the two nuchal, more or less spurred, plates. (The coronet may possibly represent a remnant of still another primitive metamere.)

FIGURE 54.—EXOSKELETON OF HIPPOCAMPUS HIPPOCAMPUS (AFTER RAUTHER)

cor.: Coronet.

nu. pl.: Nuchal plate. The two nuchal plates on the mid-dorsal surface form parts of the reduced anterior two segments, corresponding to the first two vertebrae, according to Rauther. These two segments are intimately fused with the third. All three appear externally as one irregular segment, bearing the pectoral fin, and were counted as one in this study.

tr. seg. 1: The first trunk segment as arbitrarily and uniformly adopted for the purpose of this study.

antp. tr. seg.: Antepenultimate trunk segment, showing the typical structure of a trunk segment as follows: *up. pl.*, upper plate; *med. pl.*, median plate; *l. l. pl.*, lower lateral plate; *m. v. pl.*, midventral plate. The first three plates are paired and the last is unpaired, a typical trunk segment thus being septangular in cross section.

p. tr. seg.: Penultimate trunk segment. Note that this segment is septangular like the preceding, except that the upper plate is pushed upward to occupy a position nearly in a line with the extra plates on the following two segments. The penultimate trunk segment sometimes also has an extra plate and is novemangular, depending on the species or on individual variation.

l. tr. seg.: Last trunk segment. This segment lacks the midventral plate and has an extra plate, *ex. pl.*, superimposed over that plate, which is the homologue of the upper plates of the preceding segments. This segment is always octangular, except in *zosterae*, where it is often hexangular, and sometimes asymmetrical in other species as an infrequent individual variation.

caud. seg. 1: First caudal segment. This is like the following segments except that it has an extra plate on top, and is thus hexangular. The absence of an extra plate on this segment is usually a specific character, sometimes an individual variation.

caud. seg. 2: Second caudal segment, showing *up. pl.*, upper plate, and *l. pl.*, lower plate; both are paired, and a typical caudal segment is quadrangular.

l. sp.: Last spur on lower lateral ridge, unmistakably marking the last trunk segment externally and nearly always present, except in occasional specimens having the last trunk segment asymmetrical; sometimes obsolescent.

w.: Wing from lower plate of last trunk segment extending inwardly to meet its fellow from the opposite side behind the anal fin.

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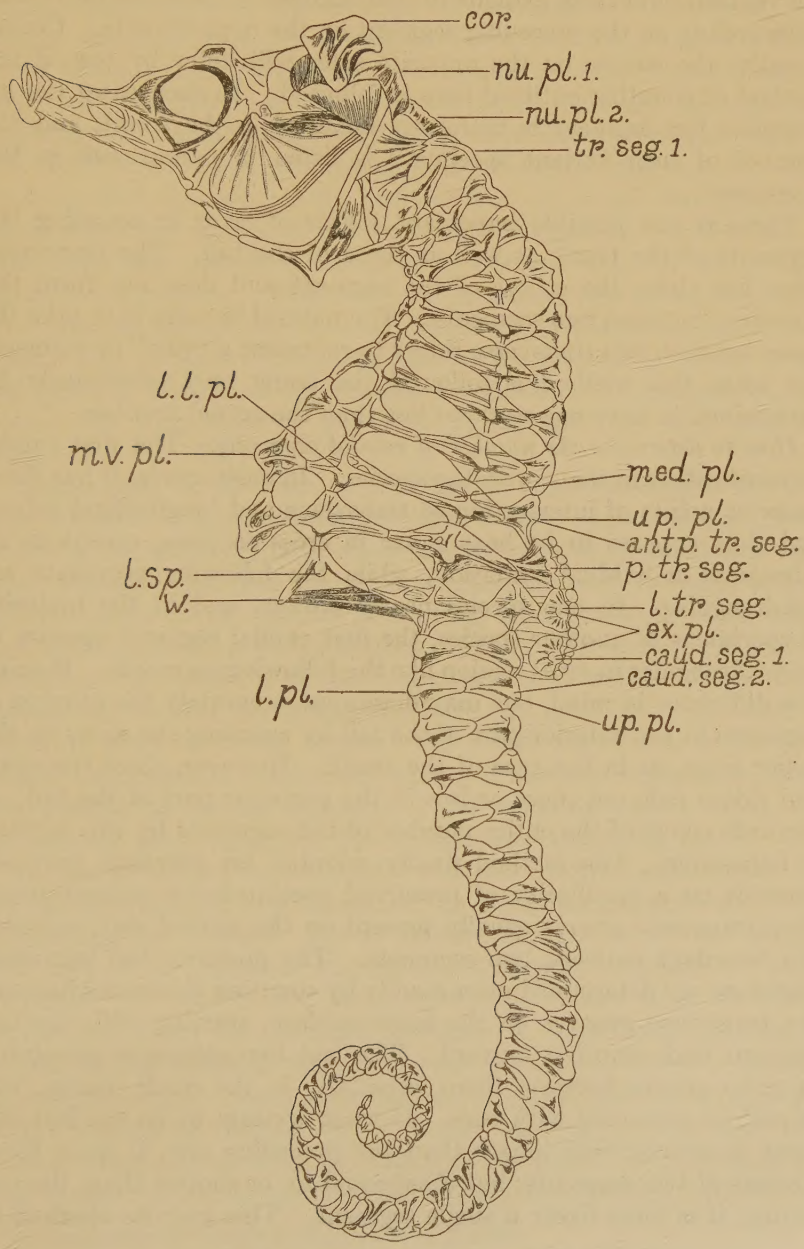
[10] Die Syngnathiden des Golfes von Neapel. Fauna und Flora des Golfes von Neapel, Monog. 36, 1925.

As far as I can judge by current descriptions of seahorses, authors generally count the first compound segment as one; but some writers apparently include the first caudal segment in the count of the trunk segments, although nearly all accounts are not clear regarding the method of counting used by their authors. Where authors definitely



[See opposite page for description]

include the first caudal segment and count the first compound segment as one, the given count of the trunk segments should be reduced by one to make it comparable with the uniform method adopted herein.

In occasional specimens the last trunk segment is incomplete, or it would perhaps be more correct to state that it is asymmetrical, since the ventrolateral ridge extends to that segment on one side only, that ridge ending on the preceding segment on the opposite side. Consequently, the counts on the opposite sides will differ by one, if the method of counting outlined here is followed. In such cases the incomplete last segment is uniformly included in the count, and the number of such variant specimens is listed in parentheses in the diagnoses.

There is one possible important source of error in counting the segments of the trunk as well as those of the tail. The transverse ridge lies along the center of the segment and does not form the boundary between two segments. The natural impulse is to take the space between two transverse ridges to represent a "ring" or segment, but when this method is followed the trunk may erroneously be determined to have one segment less than the actual number.

How to determine the number of caudal segments.—The first caudal segment differs in shape with the species. In most species it has three spurs or points of intersection of transverse and longitudinal ridges, and thus appears to be hexangular in cross sections, except as an infrequent individual variation, while the following segments are quadrangular. In one species nearly always, and in the majority of specimens of another species, the first caudal segment appears to be quadrangular in cross section like the following segments. Bearing this difference in mind, one may determine accurately the number of segments in the anterior part of the tail by counting the spurs on the upper ridge, as in the case of the trunk. However, since the spurs and ridges fade out more or less in the posterior part of the tail, an accurate count of the entire number of tail segments by this method is impossible. The method finally adopted for practical purposes depends on a peculiarity of preserved specimens—a comparatively deep transverse groove usually present on the ventral side, marking the boundary between two segments. The posterior tail segments, therefore, are determined most readily by counting the spaces between the transverse grooves on the lower surface, starting with the last segment and counting forward. The last two segments sometimes have no groove between them, especially in the small species, and should be examined with care. If what appears to be the last segment is considerably longer than the preceding one, it most likely consists of two segments; but if subequal to, or shorter than, the preceding, it is most likely a single segment. This may be checked by

flexing upward the end of the tail with the tip of a dissecting needle. It is possible that if the fish were macerated and the last one or two segments determined with absolute accuracy, the numbers would differ slightly from those given in this report. However, this is manifestly impracticable, and the difference, if any, would be very slight. In employing the method of counting here described, one should also note that there is sometimes a transverse groove on the *center* of many tail segments on the ventral side. Although sometimes confusing, this groove is nearly always much shallower than the one marking the boundary between the segments, and with a little practice the distinction between the two sorts of grooves is readily made. The grooves often disappear in the anterior part of the tail, but the transverse ridges and spines, at the center of the segments, become prominent anteriorly and aid in the accurate determination of the number of anterior segments. Where the grooves on the ventral side are indistinct, the tail may be uncoiled and its lower side placed against a glass slide. The pressure of the slide against the natural tendency of the tail to recoil brings out the boundaries between the segments on the dorsal side with more or less prominence, and they may thus be counted on that side.

Modification in structure of segments in region between trunk and tail.—Special attention should be called here to some structural characters of the species of *Hippocampus* that hitherto have received only scant attention but that are of considerable importance in the proper differentiation of the species in showing their probable relationship and in distinguishing the subgenera. I have reference to the modification in the structure of the first caudal and last trunk segment; sometimes the last two trunk segments are involved. The modification of the first caudal segment was briefly referred to in the preceding paragraph in connection with the accurate determination of the number of caudal segments. The modified nature of all the segments in that region will now be discussed in greater detail.

We are concerned herein chiefly with the external structure of the fish as seen without any dissection, for the practical purpose of distinguishing the species. For a detailed description of the minute structure of the segments, the reader is referred to Rauther [11] or to Duncker.[12] However, the gross external structure may be better understood when the detailed anatomy is considered. Briefly, a typical caudal segment consists of four plates, two dorsolateral and two ventrolateral. Each plate consists of two wings bent at an angle with a lengthwise ridge along the bend. Another, a transverse and blunter ridge, occurs along the middle of the plate. When joined the four plates somewhat overlap, are loosely ankylosed by projecting

[11] Die Syngnathiden des Golfes von Neapel, pp. 68–74, pl. 7, 1925.

[12] Syngnathiden-Studien. Mitth. Naturh. Mus. Hamburg, vol. 25, pp. 18–20, 1908.

irregularities of surface, and are tied together by connective tissue and the skin and thus form a segment. The plates of each segment also overlap with those of the adjacent segments to form one continuous ridged exoskeleton. A typical tail segment is thus quadrangular. A typical trunk segment, in addition to the four plates just described, has an irregularly oblong or elongate plate interpolated on the side between the dorsolateral and ventrolateral plates, and another, unpaired, roughly trough-shaped plate is interpolated between the two ventrolateral plates. The midventral plate is absent on the last trunk segment. The longitudinal ridges on the series of interpolated plates on the side form the lateral ridge of the trunk, while the series of troughlike plates forms the midventral ridge. The trunk thus typically has three ridges on each side and one midventral ridge, the latter extending only to the penultimate segment. A typical trunk segment is thus septangular.

The fact that the midventral ridge does not extend to the last trunk segment causes that segment to assume a different shape from the preceding one, but the chief cause of the modifications of the segments in the region where the tail and trunk meet is the structure of the base of the dorsal fin, which is on a more or less raised platform. The elevation is caused partly by one or more extra plates present there, forming a support for the dorsal. The number of extra plates and their positions differ with the species. The presence of these plates results in certain changes in the external appearance of that region, which are next described.

As already noted, a typical caudal segment is quadrangular. In most species the first caudal segment normally has an extra plate and is thus hexangular, with few individual variants; in one species, *regulus*, the first caudal segment nearly always lacks the extra plate and is normally quadrangular like the following segments; while in another species, *zosterae*, it is usually quadrangular but often hexangular, the frequency of the hexangulate condition depending on the local population of that species.

The last trunk segment nearly always bears an extra plate on top for the support of the dorsal in the species described here, and this, together with the lack of the midventral ridge, causes it to be normally octangular, with one exception, *zosterae*, in which it often lacks the extra plate and is then hexangular. The penultimate trunk segment usually lacks an extra plate, but it has a midventral ridge and is consequently normally septangular, like the segments preceding it. Sometimes, however, it has an extra plate and is then novemangular. The novemangular penultimate trunk segment is present as an individual variation with greater or lesser frequency in nearly all the species examined, becomes nearly the dominant condition in *ingens*, and is normal in the subgenus *Macleayina*.

Besides the difference in the number of angles, the extra plates to a pronounced extent also cause another effect, namely, the relation between the upper ridge of the tail and that of the trunk. The extra plates occupy a position above the upper plates of the tail segments. The longitudinal ridge formed by the extra plates is, however, continuous or nearly so with the upper ridge of the trunk. This effect is caused by one or two of the upper plates of the trunk being pushed upward to form a continuous ridge with the extra plates. For instance, if the extra plates are present on the first caudal and last trunk segments—this being the usual condition in the subgenus *Hippocampus*—the penultimate trunk segment has the position of the upper plate raised to form a nearly continuous ridge with that of the extra plates. On account of the presence of extra plates, the upper ridge of the trunks is raised sharply above and overlaps that of the tail. The tail ridge is continuous, or very nearly so, with that ridge on the last one or two trunk segments, which is immediately below the ridge formed by the extra plates. Consequently, the number of segments on which the two ridges overlap corresponds to the number of extra plates under the base of the dorsal.

It is now evident that the modification of the structure may be described in three different ways: (1) By the number of angles in each of the modified segments; (2) by the number of segments on which the two upper ridges overlap and the position of those segments; and (3) by the number of extra plates and their position. No matter what form of descriptive statement is chosen, it is to be remembered that it refers to the same fundamental structure, namely, the presence of extra plates, their number, and position. In the diagnoses that follow under each species, the variation is described first with reference to the number of angles in each modified segment, and statements are added in regard to the extra plates and the overlap of the upper ridges of the tail and trunk. All three forms of the statement, however, refer to the same fundamental structure, which is of considerable importance in classification.

Sometimes, as an individual variation, a segment may have an extra plate on top on one side only. For instance, in a species in which the first caudal segment is normally hexangular, an individual fish may lack the extra plate on one side only. Such a segment is hereafter designated as *incompletely* hexangular, octangular, or novemangular, as the case may be. While such a designation, literally speaking, is incorrect, it yet describes the fundamental condition and variation of the structure.

Proportional measurements.—The adoption of a uniform system in taking some of the measurements is especially important in the seahorses, since these fishes assume an infinite variety of forms, on account of the flexibility of the tail and the "throat" region. In

taking the measurements for this study, the tail was straightened by pressure. When the tail was much coiled and contracted it was sometimes necessary to exert considerable force to straighten and hold it in place. No attempt was made to straighten the trunk. The head was bent either upward or downward, as necessary, until its lower profile assumed a position perpendicular to the tail. With the fish held in this position, the **length** is taken to be the distance from the tip of the tail to the tip of the coronet; the **tail** is the distance between its tip to the median, lateral point on the boundary between the last trunk and the first tail segment, as defined above; while the **trunk** is the distance from the latter point to the upper margin of the gill opening. The **depth** is that of the deepest segment, usually the one on which the origin of the dorsal is situated, or the one immediately before or behind, this being in front of the brood pouch, and consequently the measurement of males having that structure much developed is fairly comparable with all other specimens. The depth is taken between the lowest points on the upper and the midventral ridge, the spines not included. The **head** is measured from the tip of the snout to the dorsal margin of the gill opening; the **postorbital** from the latter point to the posterior margin of the orbit; the **snout** from its anterior margin, on the midline, to the anterior margin of the orbit; the **orbit** between opposite points on its bony margin which is usually indicated as a slight keel but often quite indistinct (this measurement, therefore, is not susceptible of a high degree of accuracy). Since the fish is more or less contractible or distensible along its longitudinal axis, the length of the tail, the trunk, and the total length used as a standard of comparison will vary somewhat with the state of the specimen at the time of its preservation, and also with the state of preservation. This inaccuracy is inherent in the subject matter and cannot be avoided. However, if the same method is followed throughout, the figures are comparable, especially if they are based on numbers of specimens. All measurements are expressed as a percentage of the length.

The methods of counting the segments and taking the measurements are explained in detail, because it is absolutely essential to follow a uniform system; otherwise descriptions of seahorses are not of much value in the identification and distinction of the species. For instance, the trunk segments in a given species may be recorded either as 11 or 12, depending on the method of counting, as noted. Since the predominant difference of one segment is usually a good specific character, the necessity for care and uniformity of method is evident. All measurements recorded here were made with a vernier caliper.

In taking measurements, and also in counting the caudal segments, it is important to note whether the tail is broken off at the tip. Sometimes one or more caudal segments have been broken off at the tip. Usually a broken tail may be discerned readily, but in infrequent cases it has been almost perfectly regenerated and may be detected only by close scrutiny, by the unnatural stumpy appearance of the tip of the tail. In such cases proportional measurements, with the length used as the standard, are evidently of no value or may be even misleading. Consequently, measurements and the caudal segment count of such specimens have been omitted from the data here presented.

Fin rays.—An absolutely accurate count of rays in the dorsal and pectoral fins is essential, but this count is not likely to vary with different observers. Sometimes the last two, and less often the first two, dorsal rays are closely approximated. For this study such rays were enumerated separately. The pectoral rays were always enumerated on the right side, unless the fin was broken on that side, and no account was taken of any occasional probable differences in the numbers of both sides.

DIFFERENCES DUE TO SEX AND AGE

In studying seahorses it is very important to take account of the size and sex of the specimens, especially when one attempts to establish a new species. In general, younger fish of either sex differ from older individuals in having better-developed tubercles or spines, a higher coronet, a longer snout, and a slenderer trunk. The tail is somewhat shorter and the trunk longer, but these two differences are not so well marked as the preceding ones. The females differ from the males in the same way as the young of either sex differ from grown specimens, but the differences between the sexes are generally not so pronounced as those due to size. A study of tables 2 and 3 (pp. 531–533) shows these differences to hold, except in a few cases possibly due to the small number of specimens measured, in consequence of which extreme variants are likely to have a greater effect on the averages. The exceptions may also be due to the sexes not having been completely separated, as hereafter discussed, or to the inherent difficulty of taking very accurate measurements of seahorses.

Three of these differences—the relative development of the tubercles, the length of the snout, and the depth of the trunk—are also of importance in separating some of the species. It is evident, therefore, that size especially must be considered when identifying and distinguishing seahorses. It is also of considerable, though lesser, importance to compare specimens of the same sex.

The sexes may be distinguished in most species by the presence of a brood pouch in the male. Young males have at least the rudiments of a brood pouch indicated by an elliptical fold of skin or sometimes by an elliptical pigmented area on the underside of the anterior caudal segments, later developing into a brood pouch. The rudimentary brood pouch appears when the fish is quite small, the size probably depending on the species, at about 40 mm in *hudsonius*.

The brood-pouch criterion was used to separate the sexes and segregate the measurements presented in tables 2 and 3. This sex distinction does not always hold, since Rauther [13] found that the majority of the females of *brevirostris* (=*hippocampus*) and a fair percentage of the females of *guttulatus* also have the brood pouch developed, at least in rudimentary form. The sex in *europaeus* as well probably cannot be distinguished readily by the development of the brood pouch (see p. 550). It yet remains to be determined to what extent, if any, this condition occurs in other species. On account of the failure of this criterion to distinguish the sexes in all cases, it would have been desirable to separate the sexes more definitely by a histological examination of the gonads. However, by a close inspection of my rough data, I concluded that the probable greater accuracy to be attained by such an examination would result merely in showing a somewhat greater divergence or, in most cases, a lesser degree of intergradation of average differences. It seems evident also that no absolute distinction between the sexes may be made on the basis of proportional measurements. Since the available material, when sorted according to sex, size, and locality, is not sufficient for satisfactory statistical studies anyway, it was not deemed expedient to spend more time on histological studies of the gonads for the mere purpose of showing more accurately the average differences between the sexes, or drawing more finely the lines of distinction between the species.

It is significant that in nearly every species in which a fair number of specimens were examined the largest individual had a brood pouch. This would indicate that in seahorses the male attains the larger size.[14]

FILAMENTS AND OTHER APPENDAGES OF THE SKIN

The use of the presence or absence of filaments in specimens of seahorses as a character in classification has caused considerable confusion in the systematics of *Hippocampus* and has resulted in some unnecessary synonyms.

Specimens of seahorses are found now and then that have a profusion of long and branched filaments (see fig. 64). This character

[13] Die Syngnathiden des Golfes von Neapel, pp. 212–213, 1925.

[14] Gill, Proc. U. S. Nat. Mus., vol. 28, p. 809, 1905, states that the male is somewhat smaller than the female.

gives them such a striking appearance that it is hard to conceive of it as not being of importance in classification. Some species, indeed, have been based in large part on this character, as *ramulosus* (p. 518) and *kincaidi* (p. 569). My study has shown unmistakably, however, that among seahorses this character is largely due to individual variation, a conclusion to which other investigators arrived at previously (see p. 518 for definite examples cited). To some extent it is an age character—that is, filaments are oftener present in the smaller size groups, at least in the specimens examined; but in either young or full-grown specimens they may be indiscriminately present or absent. To a certain limited extent it possibly is a species character in the sense that in some species specimens with filaments or with a profusion of filaments apparently are oftener present, while in other species specimens with filaments are comparatively infrequent or the number of filaments, when present, is few. However, this slight specific difference may be discerned only after the species have been separated by other means. Taken by itself this character is of little value in classification. Indeed, in the manner in which it has been used, it has had a rather negative value.

In the species I examined, filaments on the tubercles as an individual variation were found in all except *H. europaeus*, but the eight available specimens of this species are in indifferent condition. In *hildebrandi* and *obtusus* there are a few short chunky appendages instead of slender filaments, and such appendages were observed in occasional specimens of other species also. As a result of my studies of the seahorses and a consideration of descriptions and figures in the literature, it is evident that the presence or absence of filaments or other appendages on the tubercles is highly variable. They are probably present in all or nearly all the species, in some specimens at least.

In addition to the filaments or fleshy appendages on the tubercles, seahorses are often found with pimplelike excrescences scattered over the skin, or with many very short filaments on the surface of the skin. These structures apparently also differ with age, with the individual, and to a limited extent with the species, in the same manner as do the filaments on the tubercles. The apparent development of these small excrescences probably depends also on the state of preservation of the specimens. (See further discussion under the account of *hudsonius*, p. 555.)

GEOGRAPHICAL DISTRIBUTION

In regard to the geographical distribution of the seahorses, Günther[15] makes the following statement: "They are pelagic fishes which

[15] Catalogue of the fishes of the British Museum, vol. 8, p. 198, 1870.

attach themselves to seaweed or other floating substances, and are liable to be carried by currents to great distances. Consequently, some species are spread over different parts of the globe, like *Antennarius*, a genus the geographical distribution of which nearly coincides with that of *Hippocampus*." Though this may be true of the geographical distribution of *Antennarius* or some of the species of *Hippocampus*, it certainly does not apply to some of the species discussed herein. On the contrary, two species of which a fair amount of material is available, *hudsonius* and *zosterae*, are shown here to tend to break up into distinct populations, which may be separated by the ordinary statistical methods. These stocks are found to occupy rather circumscribed geographical areas. Thus, the populations of the subspecies *hudsonius* from Chesapeake Bay and northward, from North and South Carolina, and from Mississippi to Texas show average and statistically measurable differences. This is also true regarding the populations of *zosterae* from Pensacola, Captiva Pass, and Key West. (This subject is discussed at greater length under the respective species.) The tendency to break up into distinct stocks within comparatively circumscribed geographical areas is evidently a necessary consequence of the relative immobility of the seahorse, which is a very feeble swimmer and probably spends its life attached to seaweed in the vicinity where it was hatched. Specimens of various species are sometimes pelagic and are often taken in surface towings, but such definitely pelagic specimens as I came across were immature or sexually undeveloped (p. 556). In view of the fairly distinctive character of populations inhabiting certain regions within the range of their species, it seems evident that the few pelagic specimens that may be carried outside of their range by waves and currents are not able to establish themselves, grow to maturity, and reproduce in the region of their immigration. To the erroneous idea in regard to the geographical distribution of seahorses evidently is to be ascribed, in part, the chaotic state in which the systematics of *Hippocampus* is now found. Because of the failure of authors in many cases to distinguish their specimens properly, the geographical distribution of species and subspecies is mostly unknown. The geographical range, as far as known or as indicated by material examined, is presented under each species or subspecies.

UNCERTAIN SPECIMENS

In an extensive study of variation among the species comprising a genus, some extreme variants may be found that cannot be referred to their proper species with certainty. While such specimens usually are comparatively few, they are of extreme interest and importance.

In a way they offer a challenge to the correctness of the author's conclusions. In view of the variability shown by the species and subspecies of seahorses, their near approach to one another, and their frequent overlapping, it is no wonder that there are some uncertain specimens. What is more surprising is that they proved to be comparatively few. Full-grown or nearly full-grown seahorses usually have a typical structure, color, or appearance, which in combination with the correlation of the counts and measurements of the specific characters makes it possible, with a fair degree of assurance, to refer the bulk of them to their proper species even without a previous knowledge of the locality of capture. The identification of the rest of the specimens, those that are not entirely typical, is aided by a knowledge of the locality of capture, after the known geographical distribution of the species and subspecies is taken into account. In the present study there were only three specimens of which the identification was doubtful. Each one of these is discussed separately after the account of the species or subspecies to which it is referred (pp. 542, 546, and 572).

NOMENCLATURE

There is an utter state of chaos in the literature in regard to the use of names for some very common species of seahorses in various parts of the world. This confusion, aside from the difficulty of distinguishing the species, may be traced in a large measure to Cuvier's introduction of three new names for seahorses without giving adequate accounts, having based those names largely on some crude figures previously published by Willughby; and, more particularly, to Cuvier's as well as later authors' neglect of previous binomial writers. Another fruitful source of confusion is that the first binomial name used by Linnaeus for seahorses was evidently applied to a composite of more than one species. In order to fix firmly the nomenclature of the species with which this report is concerned, a review of the pertinent literature is given. Since the nomenclatorial status of more than one species sometimes depends on a consideration of the same publications, the discussion is given here together for the several species, and the conclusions arrived at as a result of the review are pointed out again under each species concerned. Only works having a direct bearing on the nomenclature are discussed in chronological order.

Linnaeus [16] described a species of seahorse, naming it *Syngnathus hippocampus*. The work in which it was described is the starting point of zoological nomenclature, according to the International Code, and his name must be used for some species, if identifiable

[16] Systema naturae, ed. 10, p. 338, 1758.

at all. The question is, which species? Linnaeus' description of *S. hippocampus* is as follows: "Pinna caudae nulla, corpore septemangulato tuberculato, cauda quadrangulata. D. 20. P. 18. . . . Art. gen. 1 syn. 1. Syngnathus corpore quadrangulo, pinna caudae carens. D. 35 . . . Habitat in Pelago. *Laminae corporis trunci* 17, *caudae* 45."

This account is largely generic and undoubtedly includes more than one species, since some of the characters belong to widely separated and unrelated species. For instance, no species of seahorse now known has a combination of 20 dorsal rays and 45 caudal segments, although each one of those counts may be present in one species or another. Evidently Linnaeus intended to include all seahorses in one species. At any rate his description, including the given locality, applies to more than one species. Consequently, on the basis of the original account, *Syngnathus hippocampus* Linnaeus represents a composite of more than one species, and it remains to be seen how later authors restricted the use of the specific name *hippocampus*.

Binomial authors immediately following Linnaeus generally continued to treat the seahorses as a single species. What is probably the best of these earlier accounts is that of Bloch [17] under the name of *Syngnathus hippocampus*. His figure shows a long snout and the spines on the trunk and tail well developed and is a fairly good representation of the common long-snouted Mediterranean seahorse, the species later named *H. guttulatus* by Cuvier. Of the three common European species the figure would apply more nearly to that species. Also, at least part of Bloch's material evidently came from the Mediterranean. However, Bloch cannot be said to have restricted the use of the specific name *hippocampus*, as is indicated by his statement:

"* * * Dieser Fisch wird häufig an den Ufern des Mittelländischen Meeres, besonders zu Pozzuli, Neapel, in Frankreich bei Marseille, im Nordmeere, und in Indien in der Strasse Sunda angetroffen * * *. Ray, der aus demselben unrichtig vier besondere Gattungen gemacht, hat unstreitig den Klein verleitet, drei Nebengattungen anzunehmen: den die Fasern, die etwas mehr hervorstehenden Höcker und die tiefern Einschnitte zwischen den Schildern sind nur Zufälle, die vom Alter, oder der Verschiedenheit des Geschlechts herrühren."

While the variable characters enumerated by Bloch depend, as he stated, on sex and age, they also differ with the species. At any rate, his remarks as quoted, as well as the geographical distribution he gives, clearly show that he regarded all seahorses as belonging to one species.

[17] Naturgeschichte der ausländischen Fische, pt. 1, p. 7, pl. 109, fig. 2, 1786. The quotation here is from the 8vo. ed.

The next writer we have to consider is Rafinesque,[18] whose account is as follows:

"XIX G. Hippocampus—Un ala dorsale, un ala anale, nessuna caudale.—Oss. Il curioso *Syngnathus hippocampus* compone questo genere insieme col *S. tetragonus* in opposizione del quale lo chamero *H. heptagonus*."

Having established the genus *Hippocampus*, he substituted the name *H. heptagonus* for *S. hippocampus*, and this species is the type of his genus by tautonymy. The *S. tetragonus* he mentions is evidently Gmelin's species, which is now regarded as a synonym of *Syngnathoides* or *Gastrotokeus biaculeatus* (Bloch).[19] In regard to Rafinesque's restriction of the specific name *hippocampus*, two interpretations are possible: (1) Having listed the Sicilian seahorses as *H. heptagonus*, he restricted the specific name *hippocampus* for which it was a substitute to a Mediterranean species; or (2) like his predecessors he regarded the seahorses proper, the fishes now generally placed in the genus *Hippocampus*, as belonging to one species and did not in any way restrict the use of the specific name *hippocampus*. Since Rafinesque does not give an adequate account of the species, this question remains unanswered. To settle the problem of nomenclature, however, this question need not be answered, since Leach a little later more definitely restricted the specific name *hippocampus* to a Mediterranean species.

Another author whose work appeared in the same year as that of Rafinesque and has a bearing on the nomenclature of the seahorses is George Perry.[20] This work was neglected by subsequent writers, although it is superior to some publications that appeared contemporaneously. An account of it is given by Gregory M. Mathews and Tom Iredale,[21] who list four extant copies known to them. According to them, Perry's Arcana was issued serially as a monthly periodical, and the separate numbers were bound together in book form having a common title page, dated 1811. The library of the United States National Museum has an incomplete copy, which I examined; it has a written copy, but not the original, of the title page. It consists of colored plates and descriptive matter without any page or plate numbers, but the plates bear dates.

Two places in Perry's Arcana are to be considered in connection with the nomenclature of *Hippocampus*. The first is a plate dated May 1, 1810. The accompanying letter press is headed: "*Genus*—Syngnathus, or Hippocampus/*Species*—Foliatus." The heading is followed by an account of a single species, which is apparently the same as the

[18] Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, p. 18, 1810.

[19] See Weber and Beaufort, The fishes of the Indo-Australian Archipelago, vol. 4, p. 39, 1922.

[20] Arcana; or The museum of natural history . . . , 1810. I am indebted to Dr. George S. Myers and Austin H. Clark for calling my attention to this publication.

[21] Victorian Nat., vol. 29, no. 1, 1912.

Syngnathus foliatus of Shaw.[22] This species is now usually placed in the genus *Phyllopteryx* Swainson.

While Perry doubtfully erects his genus *Hippocampus*, it is probably sufficient to satisfy the requirements of the code. He evidently established his *Hippocampus* independently of Rafinesque, and the names as used by the two refer to two distinct genera by the application of the rules of nomenclature now in force. Perry's *Hippocampus* is monotypic and is based on *S. foliatus* Shaw, which is now considered to be generically distinct from *S. hippocampus* Linnaeus, the genotype of Rafinesque's genus *Hippocampus*. Since both authors published in the same year, 1810, the question comes up as to whose name has priority. Perry's plate is dated May 1, and this may be taken as the actual date of publication, although this may not be so, according to our present ideas as to what constitutes "publication." Rafinesque's work does not give the date on the title page any more specific than 1810, while his dedication is dated April 1, 1810. It is therefore possible that Rafinesque's work was published before Perry's, although this is uncertain. In any case there is room for reasonable doubt, and the actual date of publication, in a technical sense, of either work may never be determined with certainty. In a doubtful case such as this, current and well-established usage should be followed. Rafinesque's work, therefore, is assumed to have priority, and the generic name *Hippocampus* is here used in the same sense as it has almost universally been employed by systematists.

Even if it were definitely proved that Perry's work has priority, it would still be most desirable to continue the use of the name *Hippocampus* for the seahorses. This clearly is a case where to follow the law of priority would cause more confusion than to follow general usage. Indeed, it would be nothing short of the ridiculous to replace a name that has been used by nearly all authors, including some pre-Linnaean writers, and to substitute another name for it because of the discovery of an old neglected publication of which only a few copies are in existence. Even Perry himself placed the seahorses proper in his genus *Hippocampus*, but his first monotypic use of that name may have to be applied to a different genus according to the rules.

The other place in Perry's Arcana to be considered is a plate of a seahorse dated December 1, 1810. The accompanying letter press is headed: "*Genus*—Syngnathus; or, Hippocampus/ *Species* Erectus." The locality is given as "native of the American seas, and of the coasts adjacent to Mexico and the West Indies." Perry does not state whether he describes a new species or substitutes the specific

[22] General zoology or systematic natural history . . . , vol. 5, p. 456, pl. 180, 1804.

name *erectus* for *S. hippocampus* Linnaeus to avoid tautonymy. Since he gives no reference to Linnaeus and since the locality given by Perry is different from that given by Linnaeus for his *S. hippocampus*, we have to assume that he intended here to describe another species of the genus *Hippocampus* as understood by him; and Perry cannot be said to have definitely restricted the specific name *hippocampus* of Linnaeus. Perry's account of his *erectus*, in the figure, the inadequate description, and the locality, agrees most nearly with the seahorse here recognized as *punctulatus*, but this is not at all certain, and the name *erectus* is here doubtfully placed in the synonymy of *punctulatus* (see remarks on p. 566).

Leach [23] quite definitely restricted the use of the specific name *hippocampus*. This author evidently established the genus *Hippocampus* independently, since he refers neither to Rafinesque nor to Perry. Leach splits up the seahorses proper, apparently being the first binomial and post-Linnaean writer to do so in a single issue of a publication, into three species: (1) *H. trimaculatus*, a new species, which he states to be "very abundant in the Indian and Chinese seas"; (2) *H. antiquorum* from the Mediterranean; and (3) *H. ramulosus*, a new species described from material in the "Mus. Britain." without any definite locality. Leach's account of *H. antiquorum* is as follows:

"H. corpore angulis subtuberculatus; crista rugosa; oculis superne gulaque utrinque tuberculo obtuso armatis. / Syngnathus Hippocampus. *Auctorum.* / Habitat in mari Mediterraneo, a Dom Risso optime descriptus. / Common Hippocampus. / Angles of body slightly tuberculated; crest rough; eyes above and throat on each side armed with an obtuse tubercle. / Inhabits the Mediterranean sea, and is well known under the titles, *Sea-horse*, or *Cheval-marin.*"

Leach, having established the genus *Hippocampus*, evidently substituted the name *H. antiquorum* for *S. hippocampus* to avoid tautonymy; and having split up the seahorses into three species he restricted the specific name *hippocampus*, for which he substituted *antiquorum*, to a seahorse occurring in the Mediterranean. We know now, however, that there are two common and distinct species of seahorses on the northern coast of the Mediterranean, one with a short snout and blunt tubercles and the other with a longer snout and pointed and better-developed tubercles, and the question then comes up as to which species of the two the name *hippocampus* is to be applied. Leach gives under his *antiquorum* "angles of body slightly tuberculated", while for his *ramulosus* he gives "angles of body tuberculated." Since he paid due attention to that character, the name *antiquorum* was based on the Mediterranean species having nearly

[23] The zoological miscellany, vol. 1, pp. 103–105, 1814.

obsolescent tubercles and a short snout. Linnaeus' name *hippocampus*, for which *antiquorum* was a substitute, must therefore also be used for the common short-snouted Mediterranean species.

Leach's *ramulosus*, from an unknown locality, apparently is based largely on the presence of many rather long, branched filaments. The original account may apply to several species. For instance, some younger specimens of *hudsonius* and *punctulatus* that I have examined approach closely the figure of *ramulosus* in the nature of the development of their filaments. Rauther [24] figures a specimen of *H. hippocampus* having quite a number of branched filaments, and one of *guttulatus* [25] having many rather long though simple filaments. I also found filaments present in variable numbers in all species of which well-preserved specimens were available, and this is probably true of all species of *Hippocampus* (p. 511).

It is evident that *ramulosus* cannot be distinguished definitely on the basis of the original account, and the difficulty of its final determination is increased by the absence of a definite locality record. Risso cites Leach's species 3, or *ramulosus*, in the synonymy of his *antiquus*, which, in turn, is a synonym of *hippocampus* (see p. 521), but this action does not seem to be well taken. The original figure of *ramulosus* shows a rather deep body, more as in *hippocampus*, but the tubercles are distinctly higher than in *hippocampus* and more nearly resemble those of *guttulatus*. The depth, and length of the snout, would also not absolutely preclude it from being a *guttulatus*. Rauther (see preceding paragraph) figures a specimen of *guttulatus* having filaments nearly to the same extent as shown on the figure of *ramulosus*, although in Rauther's fish the filaments were not branched. When the original account of *ramulosus* is considered in connection with the specific characters of the common European species as established here, the probabilities favor the conclusion that *ramulosus* was based on a specimen of *guttulatus*, and Leach's name is here placed in the synonymy of *guttulatus*. This action should be considered final, unless, of course, a restudy of the type should prove otherwise; the question must be left open for those who may have a chance to reexamine the original specimen.

The third species established by Leach, *trimaculatus*, falls outside the scope of this paper.

The next author whose work has a bearing on the nomenclature of the seahorses is Cuvier,[26] who also established *Hippocampus*, as a subgenus, possibly again independently, since he does not refer that name to any previous author. After describing his subgenus, he states:

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[24] Die Syngnathiden des Golfes von Neapel, pl. 16, fig. 173, 1925.
[25] Ibid., pl. 2, fig. 12.
[26] Le règne animal. . ., vol. 2, p. 157, 1817.

"Il s'en trouve dans nos mers une espèce à museau plus court, pointillée de blanc. (*Syng. hippocampus* L.) Bl. 109, fig. 3. Et une autre à museau plus long, Will. I. 25, f. 4, qui n'ont toutes deux que quelques filaments sur le museau et sur le corps."

Cuvier thus differentiates two species in "nos mers", correctly giving one striking character that distinguishes them. For one he cites the name *Syngnathus hippocampus*, but leaves the other unnamed. (This was later named by Schinz.)

We must digress here from the regular chronological arrangement of this review and turn briefly to Willughby.[27] This author is pre-Linnaean and largely nonbinomial, and his work need not be considered by itself. In the preceding quotation, however, Cuvier cites one of Willughby's figures, and this account by Cuvier later formed the basis of Schinz's *longirostris*. Also, Cuvier still later established three species citing Willughby's three figures, one for each of his species. The accounts of these two post-Linnaean authors are very inadequate, and in order to dispose of their names properly a consideration of Willughby's account becomes important.

The section in Willughby's book dealing with the seahorses is headed: "Hippocampus Rondeletii & aliorum. . ." No other species is mentioned by name in the letter-press account, which is largely generic and insufficient to distinguish separate species. His work also includes a plate containing, among others, three crude figures of supposedly distinct species of seahorses. Figure 3 is labeled "H Rond.", while figures 4 and 5 are named polynomially, but the alleged specific characters implied in these polynomial designations are insufficient to distinguish the species. Figure 3 shows a short snout and is probably a poor representation of the common short-snouted Mediterranean species. Figure 5 shows a medium long snout, while figure 4 shows a notably long snout, but neither figure is definitely recognizable. As to localities, for figure 5 "India Ocidentalis [sic]" is given on the plate after the polynomial designation. No localities are given on the plate for the other two figures. In his letter-press account the only localities he mentions are Mediterranean, and his intention apparently was for figures 3 and 4 to represent Mediterranean species, but this is not altogether certain. Since a knowledge of the locality to be assigned to figure 4 is of importance in disposing of the names later based on that figure, it may be noted that Cuvier first cited (see above) that figure under a species from "nos mers", which he characterized but did not name. Whatever Willughby's intention was, this citation by Cuvier evidently restricted Willughby's figure 4 to a French species.

[27] Historia piscium . . ., pp. 157–158, tab. I 25, figs. 3–5, 1686.

To return to the chronological arrangement of the post-Linnaean authors, we next take up Schinz.[28] The account of the seahorses by this author, which was neglected by most later writers, is as follows, in full:

"Das Seepferdchen, Hyppocampus brevirostris./Syngnath. hippocampus. Bl. 109. F. 3./Der Rumpf sieben, der Schwanz viereckig, der Rüssel vollkommen walzenformig, weiss punktirt. Im Mittelmeer und andern Meeren**)." In a footnote, as indicated, he adds, "**Hyppocamp. longirostris. Will. I. 25. F. 4. Beide arten haben nur einige Muskelfasern am Körper."

Evidently Schinz merely supplied names to the two species found in "nos mers", as differentiated by Cuvier (1817), although the locality Schinz gives is somewhat different from that given by Cuvier, "Mittelmeer und andern Meeren" instead of "nos mers." There is no question as to the disposition of Schinz's name *brevirostris*. Since he cites *S. hippocampus* in the synonymy of that species, he evidently substituted *brevirostris* for *hippocampus* to avoid tautonymy. Therefore, Schinz's *brevirostris* must be suppressed as a synonym of *hippocampus*. The latter name is thus restricted by Schinz to a short-snouted species, and since it was previously restricted by Leach to a Mediterranean species, it must be used for the common short-snouted Mediterranean seahorse, a conclusion to which we previously arrived (p. 518).

There may be some question as to the disposition of the name *longirostris*. Did Schinz intend to apply the locality "Mittelmeer und andern Meeren" to *brevirostris* only, or to *longirostris* as well? And if the latter is answered affirmatively, did Schinz intend to include all long-snouted seahorses in one species, or to apply *longirostris* only to those found in French waters? It is futile, however, to speculate now regarding his intention. The question must be determined by the available evidence. Schinz's work is virtually a translation, or at least a rendering closely following that of Cuvier (1817), including the account of the seahorses, with the exception noted in the preceding paragraph. The chief characters that Cuvier used to distinguish his two species are now employed by Schinz to coin the Latin names of those species. Schinz, as well as Cuvier, cites Willughby's figure 4, and that figure, outside the structural character implied in Schinz's name, is practically the sole basis of his *longirostris*. Schinz's account, therefore, is virtually based on that of Cuvier, and the name *longirostris* must be applied to a species from "nos mers" or to a long-snouted seahorse occurring in French waters. It will be shown hereafter that the long-snouted seahorses on the coasts of France consist of two subspecies, one in the Atlantic and another in the Mediterranean, and it becomes necessary further

[28] Das Thierreich von Cuvier, vol. 2, p. 262, 1822.

to restrict Schinz's *longirostris*. As far as I know this was not done by any previous author, and the name *longirostris*, therefore, is here formally restricted to a seahorse from the Mediterranean.

Risso [29] described two species of seahorses, *H. antiquus* and *H. rosaceus*. The descriptions are evidently erroneous in some important particulars, somewhat conflicting in their statements when compared with specimens of the common species, and he apparently relied on the color to a large extent to distinguish the species. A comparison of his two descriptions, however, allows the identification of Risso's species with some measure of confidence. For the first-named species he states: "Angulis subtuberculatis; * * * la queue présente quatre faces longitudinales avec quartre rangées d'anneaux ornés d'une houppe de filaments déliés; la tête est grande, le museau étroit * * * couleur générale d'un vert obscur varié de teintes brunes"; while for the second species he states, "la tête est plus grosse, le museau un peu plus large * * * sa surface est d'un beau rose tendre, pointillée de blanc et d'azur* * *." A comparison with the two common Mediterranean species will show that these statements give a fair although incomplete characterization by which the two species may be distinguished. Therefore, as far as the original accounts are concerned, *antiquus* becomes a synonym of *hippocampus*, and *rosaceus* has been anticipated by *longirostris* Schinz. The rose color, which Risso describes for his *rosaceus*, is a certain color phase sometimes found in either species, according to Rauther.[30]

As mentioned, Risso's statements are rather conflicting, as when he describes *antiquus* in his Latin diagnosis as having "angulis subtuberculatis", and farther on, in the description, states, "le corps * * * ceint de treize anneaux garnis de tubercules pointus." As far as the adults are concerned the presence of pointed tubercles would apply more nearly to the long-snouted species, but also to young specimens of the other species, *H. hippocampus*, and Risso may have drawn that statement from young fish. It is also quite possible that he did not properly separate his material, having relied on color to a large extent, and that his *antiquus* is a composite of two species, but on the basis of the original descriptions the best disposition of his two names is as indicated. In any case, the disposition of his names does not affect the nomenclature and merely relates to the proper segregation of the synonymy, since Risso has been anticipated and earlier names are available for both common Mediterranean species.

Cuvier [31] introduced three names for seahorses, as follows: "Il s'en trouve dans nos mers une espèce à museau plus court (*Hipp. brevi-*

[29] Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes maritimes, vol. 3, pp. 183, 184, 1826.

[30] Die Syngnathiden des Golfes von Neapel, pl. 2, figs. 15–16, 1925.

[31] Le règne animal . . ., ed. 2, vol. 2, p. 363, 1829.

rostris, N.), Will., pl. J. 25, fig. 3. Et une autre à museau plus long (*Hipp. guttulatus*, N.), Will. J. 25, f. 5, qui n'ont toutes deux que quelques filaments sur le museau et sur le corps. Il y en a aussi de voisines dans les deux Indes.[1]" In a footnote, as indicated, he adds: "[1]*Syng. longirostris*, N., Will., J. 25, f. 4, et d'autres espèces que nous ferons connaître dans notre grande Ichtyologie."

Comparing this with Cuvier's account in his first edition of "Le Règne Animal" (see p. 519), we note that both accounts are essentially the same. He even employs the same phraseology in describing the two French species that he recognized. He now supplies the two French species with names and also names a third species from "les deux Indes." However, while his description is essentially the same in both editions, he makes some important changes in his citations. For the short-snouted French species he substitutes the reference to Willughby's figure 3 for that to Bloch; for the long-snouted French species he now cites Willughby's figure 5 instead of figure 4, although Willughby assigns figure 5 to a West Indian species; and he introduces a third species, *longirostris*, from "les deux Indes", for which he cites figure 4, although previously, in 1817, he assigned figure 4 to a species from "nos mers." A study of the species and a comparison with the figures of Willughby and Bloch make Cuvier's intention apparent. The snout in Willughby's figure 3 is approximately the same as in either one of the two short-snouted French species; figure 5 instead of figure 4 has the snout more nearly like the long-snouted French species, while seahorses with snouts more or less the same length as in figure 4 are present in the Indo-Pacific region. Cuvier apparently now examined specimens of this notably long-snouted species and changed his citations to accord more nearly with his newly acquired material. His intention then was to cite Willughby's figures as examples of what the material he examined looked like, rather than to accept Willughby's account in full. Evidently, for this same reason, his first reference to Bloch's figure under the short-snouted seahorse is omitted in the second edition, because that figure shows a rather long-snouted species, and this was, consequently, also a necessary correction. Such an explanation becomes apparent after one becomes familiar with the appearance of the species.

Comparing Cuvier's account with that of Schinz makes it evident that the *brevirostris* of both is the same species and is to be replaced by *hippocampus*, as already shown. Like other early authors, Cuvier, being opposed to tautonymy, changed the name of a species when it corresponded with the generic name, and evidently adopted the name first proposed by Schinz for that species. However, for his other French species, the one having a "museau plus long" and inhabiting "nos mers", Cuvier does not adopt Schinz's name *longirostris*, probably regarding it as inappropriate, since he apparently

now had a species with a still longer snout from "les deux Indes"; and he consequently introduces a new name, *guttulatus*, for the French species. Although he does not definitely state so, his *guttulatus* must be regarded as a substitute for Schinz's *longirostris* on the basis of available evidence, both of those names having been based on the same account, in the first edition of Cuvier's "Le Règne Animal." Since two subspecies of long-snouted seahorses exist on the coasts of France, one in the Atlantic and another in the Mediterranean, it becomes necessary to restrict the name *guttulatus* also. It seems that no previous author made this restriction, although I do not have all the literature readily available for consultation. Since the name *guttulatus* was evidently proposed as a substitute for *longirostris* Schinz, the two names must go together. Anyway, *guttulatus* is herewith formally restricted to the population of the common long-snouted species, which occurs on the northern Mediterranean coast. Cuvier's statement "museau plus long" also applies more nearly to the Mediterranean seahorse, which averages a longer snout than its Atlantic close relative designated below as *multiannularis* (see table 2). Furthermore, the best and most adequate current accounts of *guttulatus* are based largely on Mediterranean specimens. I follow general usage and continue to employ Cuvier's name *guttulatus* for that subspecies rather than Schinz's earlier name *longirostris* (p. 546).

Cuvier's *longirostris* from "les deux Indes" was evidently not intended to be the same as the *longirostris* of Schinz, although both refer to Willughby's figure 4. That figure was previously restricted by Cuvier (1817) to a French species for which Schinz subsequently proposed the name *longirostris*. Cuvier's later (1829) assignment of the same figure to a species from "les deux Indes", therefore, must be held nomenclatorially untenable, although zoologically it was an appropriate emendation, the long-snouted seahorses from the Indo-Pacific region having their snout more nearly as shown in Willughby's figure 4. Consequently, the *longirostris* of Cuvier is a composite of two things: (1) A figure, nomenclatorially at least, belonging to a French species, and (2) a locality belonging to a different species. If we exclude the figure, *longirostris* of Cuvier becomes a nomen nudum, and if the locality is excluded, it must be regarded nomenclatorially to be the same as *longirostris* Schinz. Moreover, it is preoccupied by *longirostris* Schinz. In any case, therefore, it is untenable. The name *H. longirostris* Cuvier was later used for two distinct species of seahorses in different parts of the world, first by Schlegel [32] for a Japanese species and later by Kaup [33] for a West Indian species. The West Indian species has been renamed as a

[32] *In* Siebold's Fauna Japonica, Pisces, p. 274, 1842.

[33] Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 12, 1856.

result of the present study (see p. 572), while the Japanese species was supplied with a name by Jordan and Snyder.[34]

Finally, it is necessary to discuss a short note on *Hippocampus* published by de la Pylaie.[35] His account is as follows:

"Parmi les petites espèces qui complètent cette classe, nous avons encore les Syngnathes proprement dits, *Syng. Acus. Pelagicus* Linn. ou *Aciculus* Dep., *S. Rondeletii*, *Ophidion*, auxquels il faut ajouter l'Hippocampe, *Hippocampus*, dont l'espèce de l'océan, *H. atrichus*, N., est distincte d'une autre, *H. Jubatus*, ainsi nommé d'après des filaments qui composent, le long de sou cou, une espèce de crinière peu fournie."

This author based his new species, *atrichus*, entirely on the difference in the relative development of the filaments, a character that does not distinguish any one species. Probably in all species of *Hippocampus* the relative development of the filaments or even their entire absence is due to individual variation, and to a certain extent it is dependent on age, as has been discussed at greater length (p. 510). Since this is the only character mentioned by de la Pylaie, his description of *atrichus* is applicable to every species of *Hippocampus* and can be regarded practically as nothing more than a nomen nudum, or at the most as an unidentifiable species.

What de la Pylaie understood as "*H. Jubatus*" is not clear to me. I do not know of any other post-Linnaean writer who applied that name to a seahorse; it is probably cited from some pre-Linnaean author. Perhaps he had the following statement by Willughby [36] in mind: "Vidimis Venetiis hujus generis jubatum, nescimus an specie diversum, an aetate aut sexsu tantum." If de la Pylaie cited *jubatus* as the name of a pre-Linnaean writer, it evidently cannot be recognized in nomenclature; even if it had been established by that author, it is a nomen nudum and of no standing in nomenclature.

To dispose of de la Pylaie's two names, they are here placed doubtfully in synonymy, *jubatus* in that of *hippocampus* and *atrichus* in that of the new subspecies *multiannularis*, here described from the Bay of Biscay. The name of de la Pylaie is not adopted for the new subspecies because it was based on a misapprehension and would give an incorrect description of the species. While any legitimately established name stands even though it erroneously describes the species, in the present case we are not obliged to perpetuate de la Pylaie's error.

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[34] Proc. U. S. Nat. Mus., vol. 24, p. 14, pl. 8, 1901.

[35] Recherches en France sur les poissons de l'océan pendant les années 1832 et 1833. Congr. Sci. France, Poitiers, 1834, 2d sess., p. 528, 1835. Dr. Carl L. Hubbs kindly called my attention to this reference, and the quotation given is taken from Dr. Hubbs' letter, the original account not being available for consultation.

[36] Historia piscium . . . , p. 158, 1686.

To sum up briefly the foregoing review of the literature, *hippocampus* Linnaeus must be applied to the common short-snouted Mediterranean species as restricted by Leach. The specific names *heptagonus* Rafinesque, *antiquorum* Leach, and *brevirostris* Schinz, having been proposed as substitutes for *hippocampus*, must be reduced to the synonymy of that species. The names proposed for the long-snouted European species are *longirostris* Schinz (1822) and *guttulatus* Cuvier (1829). The latter is a substitute for the former, and both names must go together. The later name is here employed, in accordance with universal usage. Since the Mediterranean long-snouted seahorse is now shown to be subspecifically distinct from that of the Atlantic, the name *longirostris* and its substitute *guttulatus* are here restricted to the Mediterranean subspecies, to accord with general usage. Risso's two names, *antiquus* and *rosaceus*, are referred to the synonymy of *hippocampus* and *guttulatus*, respectively. De la Pylaie's *atrichus* is unidentifiable, while his *jubatus* is unavailable either because it is pre-Linnaean or else because it represents a nomen nudum. These names are disposed of by placing them in the synonymy of *multiannularis* and *hippocampus*, respectively. The specific names *erectus* Perry, 1810, and *ramulosus* Leach, 1814, are doubtfully referred to the synonymy of *punctulatus* Guichenot, 1853, and *guttulatus* Cuvier, 1829, respectively.

I have based this discussion entirely on the published accounts, not having opportunity to examine original material. Since the original material, in some cases at least, evidently represented composites of more than one species, and since the early writers were not in the habit of designating "holotypes", the conclusions drawn from the original accounts will probably have to stand; but it may be necessary to modify these conclusions if it is ever possible to examine some of the original material.

Genus HIPPOCAMPUS Rafinesque

Head forming an angle with the trunk, movable up or down for a considerable distance, with the "throat" region as its axis. Brood pouch an enclosed naked sac under anterior part of tail. Pectoral, dorsal, and anal fins present, caudal absent. Tail prehensile; quadrangular; except first segment, normally hexangular in nearly all species; sometimes quadrangular (as a rather infrequent individual variation, in most species, and becoming the dominant condition in the subgenus *Jamsus*). Trunk septangular, except the posterior segments; last segment typically octangular (often hexangular in *zosterae*); penultimate trunk segment usually septangular, sometimes novemangular (as an infrequent individual variation in most species, becoming nearly dominant in *ingens* and being the normal condition

in the subgenus *Macleayina*). Extra plates on top for support of dorsal usually two, varying one to three; usually on first caudal and last trunk segments, sometimes also on penultimate trunk segment, sometimes either on last trunk or on first caudal segment only. Upper ridge of trunk discontinuous with upper ridge of tail, the two ridges usually overlapping on two segments, varying one to three, on those segments having extra plates for support of the dorsal. (For a full discussion of the correlation between the extra plates, the modified segments, and the overlap of the ridges, see pp. 505 to 507.) Median ridge of trunk continuous with lower ridge of tail; lower lateral ridge of trunk ending on last segment; midventral ridge of trunk ending on penultimate segment. A lateral expansion or wing extending from lower plate of last trunk segment, converging with its fellow from the opposite side and uniting behind base of anal fin. Points of intersection of transverse and longitudinal ridges bearing pointed spinous processes in the very young, usually persistent as short tubercles in grown specimens, in some species becoming nearly obsolescent or reduced to low stumps, the tubercles usually somewhat better developed in females. Lateral line present, indicated by a series of paired, minute, pimplelike appendages, each pair forming tiny lips for a minute slitlike pore; a pair of lips on transverse ridge of each segment, the series of pairs arranged regularly in a nearly straight longitudinal line, running on trunk nearer to median lateral than to upper ridge continued in a nearly straight line on the tail, situated there nearer to upper than to lower ridge. Appendages on tubercles and coronet often present, often branched, often altogether absent, depending on individual variation and to a certain extent on age and on the species (see p. 510).

KEY TO THE SUBGENERA AND THE AMERICAN AND EUROPEAN SPECIES OF HIPPOCAMPUS [37]

a^1. Dorsal rays 16 to 31. Pectoral rays 13 or more. Upper ridges of trunk and tail usually overlapping on two or three segments, infrequently on one (in *hudsonius* as an individual variation). First caudal segment hexangular, infrequently quadrangular as an individual variation. Base of dorsal over 3 to 6 segments, usually including first caudal segment.

b^1. Dorsal rays 26 to 31. Caudal segments 44 to 49. Upper ridges of tail and trunk usually overlapping on three segments. Dorsal usually over 6 segments. Trunk segments 12 or 13.. Subgenus **MACLEAYINA** (p. 529)

b^2. Dorsal rays 16 to 21. Caudal segments 33 to 40. Upper ridges of tail and trunk usually overlapping on two segments, infrequently on one or three as an individual variation (with exception of *ingens* about as often on three as on two). Dorsal usually over 3 segments, sometimes partly or wholly on a fourth segment....Subgenus **HIPPOCAMPUS** (p. 530)

c^1. Trunk segments normally 11, sometimes 12, rarely 10 as an individual variation (10 segments in one specimen of *hudsonius* out of entire number studied).

d^1. Tubercles on upper ridge either well developed and more or less pointed or at least narrowly rounded above, or else nearly obsolescent, not in the form of broad and low stumps.

e^1. Tubercles on upper ridge comparatively well developed and conspicuous, at least in specimens up to about 150 mm long (except usually obsolescent on trunk in large males of *punctulatus* and *kincaidi* less than 150 mm long).

f^1. Trunk without dark transverse lines or large blotches; white dots on side of trunk numerous. Northern Mediterranean, eastern Atlantic, and eastern Pacific coasts.

g^1. Snout in medium-sized females (118 mm or less) long, more than 10 percent of length; relatively long also in males when like sizes are compared; trunk comparatively slenderer when like sizes are compared (see table 2). Whitish dots often very profuse, minute, and subequal all over, tending to form very fine white streaks. Profusely covered with small dark spots. Penultimate trunk segments about as often novemangular as septangular (slightly oftener novemangular in the specimens examined). Attains to a large maximum size. Pacific coast of North and South America...ingens (p. 534)

g^2. Snout not more than 9.9 percent of length in both sexes in medium and large specimens. Trunk averages deeper. Whitish dots usually not so profuse, coarser on trunk and head, often coalescent there to form short irregular bands or

[37] The purpose of this key is twofold: (1) To give a synopsis of the most important specific characters in concise form, and (2) to facilitate the identification of specimens. The student is warned, however, not to expect to be able to "run down" specimens in every case by the use of this key. It is impossible to construct such an ideal key for the species of *Hippocampus*. One important drawback to the construction of such a key in this genus is the necessity of using the structure of the tubercles for specific distinctions. While the differences may be appreciated readily when specimens are directly compared, it is impossible to convey in descriptive phrases an adequate picture of these differences. Moreover, the structure of the tubercles differs considerably with size and sex in the same species, and human language is not gradated finely enough to express these differences and their variation, except in general terms. This key, therefore, may be used to full advantage only in connection with authentic specimens for comparison. However, at least full-grown or medium-sized fish may be identified by the use of this key, together with the tables giving the frequency distributions of the meristic characters and the ranges of proportional measurements, and with a knowledge of the locality of capture of the specimens to be identified.

elongate spots. Many small dark spots typically absent. Penultimate trunk segment septangular in a decidedly predominant number of specimens, sometimes novemangular. Attains to but a medium maximum size.

h^1. Snout 7.7 to 9.9 percent of length in medium-sized and large specimens of both sexes. Pectoral rays 15 to 18.

i^1. Caudal segments modally 39, varying 38 to 40; dorsal rays modally 20, varying 19 to 21. Snout averaging shorter, postorbital longer, trunk longer and slenderer (see table 2). White dots coarser and more numerous. Atlantic coast of Europe____**guttulatus multiannularis** (p. 540)

i^2. Caudal segments modally 38, varying 36 to 39; dorsal rays modally 19, varying 18 to 21. Mediterranean coast of Europe_____**guttulatus guttulatus** (p. 543)

h^2. Snout 5.9 to 7.3 percent of length in medium-sized specimens of both sexes. Pectoral rays 13 to 15. Caudal segments 36 to 38. Dorsal rays 17 to 19. Atlantic coast of Europe. **europaeus** (p. 546)

f^2. Trunk with large yellowish or whitish or variegated blotches in young, usually partly or wholly replaced with brownish lines in full-grown specimens. White dots on side of trunk very sparse. Western Atlantic.

g^1. Caudal segments usually 36 to 38, varying 35 to 39; dorsal and pectoral rays in comparatively smaller average numbers; trunk in full-grown specimens rather deep; tubercles well developed; snout medium; white dots usually not profuse. Atlantic and Gulf coasts of United States, north and west of Florida_____**hudsonius hudsonius** (p. 551)

g^2. Caudal segments usually 35 to 37, varying 33 to 37; dorsal and pectoral rays in comparatively larger average numbers; trunk in full-grown specimens notably deep; tubercles comparatively not so well developed, sometimes nearly obsolescent in full-grown males; snout rather long; white dots usually profuse except on side of trunk. Florida and Cuba. **hudsonius punctulatus** (p. 561)

g^3. Caudal segments usually 35 or 36, varying 33 to 36; dorsal rays in comparatively smaller average numbers; pectoral rays in medium numbers; trunk of medium depth; tubercles usually rather low, tending to become nearly obsolescent in large males; snout medium. Bermuda_____**hudsonius kincaidi** (p. 568)

e^2. Tubercles on upper ridge in medium-sized and large specimens obsolescent or nearly so, or very low and narrowly rounded above, not pointed, not forming broad stout stumps. Typically covered profusely with small brown spots.

f^1. Snout 6.1 to 7.9 percent of length and depth 16.4 to 19.4 in specimens 68 to 104 mm long. Pectoral rays modally 14, varying 13 to 15. Coronet blunt but not low. Tubercles on upper ridge of trunk usually evident as low rounded elevations. Mediterranean_____**hippocampus** (p. 570)

f^2. Snout 10 to 12.7 percent of length and depth 12 to 15.3 in specimens 58 to 137 mm long of both sexes. Pectoral rays usually 15 or 16, varying 15 to 17. Coronet very low. Tubercles on upper ridge of trunk mostly obsolescent in large specimens. Panama to Bermuda_____**reidi** (p. 572)

d^2. Development of tubercles on upper ridge peculiar, low, stout, and blunt, not pointed, not obsolescent; in form of low knoblike stumps. Slender, depth in medium-sized specimens not over 13.7 percent.

e^1. Dorsal rays 17; caudal segments 35. Atlantic coast of United States ---------- **obtusus** (p. 576)

e^2. Dorsal rays 20 to 21; caudal segments 39. Pacific coast of Panama. **hildebrandi** (p. 579)

c^2. Trunk segments 10 (one specimen examined). Tubercles well developed and pointed. With large blotches. Trunk deep ---- **villosus** (p. 582)

a^2. Dorsal rays 10 to 14. Pectoral rays 10 to 12. Upper ridges of trunk and tail normally overlapping on one segment, infrequently on two, rarely on none. First caudal segment oftenest quadrangular, sometimes hexangular (an infrequent individual variation in *regulus*, frequent in *zosterae*). Base of dorsal normally over two segments, usually the last two trunk segments, sometimes over the first caudal and last trunk segments. Trunk segments usually 10, sometimes 9, infrequently 11. Caudal segments 28 to 34 ---------- Subgenus **JAMSUS** (p. 584)

b^1. Dorsal rays with mode decidedly at 11, varying 10 to 12. Caudal segments usually 29 to 31, varying 28 to 32. Trunk segments nearly always 10. Maximum size 34 mm. Mississippi and Texas coasts; Campeche, Mexico ---------- **regulus** (p. 584)

b^2. Dorsal rays with mode decidedly at 12, varying 11 to 14. Caudal segments usually 31 to 33, varying 30 to 34. Trunk segments 9 or 10 (depending on the racial stock), sometimes 11. Maximum size 44 mm. Florida, Biscayne Bay to Pensacola ---------- **zosterae** (p. 589)

Subgenus MACLEAYINA Fowler

Macleayina FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, p. 426, 1907. (Genotype: *Hippocampus abdominalis* Lesson=*H. bleekeri* Fowler by original designation.)

This subgenus was originally established on the basis of the increased number of dorsal rays. Correlated with this is the position of the dorsal base, usually on one caudal and five trunk segments. It also differs in having the upper ridges of tail and trunk overlapping normally on three segments instead of on two, the dominant condition in the subgenus *Hippocampus*. While this difference may seem slight, it is correlated with a more fundamental difference in structure, each segment on which the two ridges overlap also having an extra plate on top for the support of the dorsal (see pp. 505 to 507). In this respect the species *ingens* is somewhat intermediate between *Macleayina* and *Hippocampus*. *Macleayina* also has an increased number of caudal segments and a higher average number of trunk segments. According to McCulloch [38] it contains five species. Of the species listed by McCulloch, however, *bleekeri* and *agnesae* have been synonymized with *abdominalis* by Fowler,[39] while *graciliformis* has been placed in the synonymy of the same species by Waite and Hale.[40] The one or

[38] Mem. Australian Mus., vol. 5, p. 97, 1929.
[39] Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 446, 1921.
[40] Rec. South Australian Mus., vol. 1, p. 319, 1921.

more species comprising this subgenus are geographically outside the scope of the present paper, and, moreover, sufficient material for comparison is not available. Consequently, the species are not treated further here.

Subgenus HIPPOCAMPUS Rafinesque[41]

Hippocampus RAFINESQUE, Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia . . ., p. 18, 1810. [Genotype: *H. hippocampus* (Linnaeus) = *Syngnathus hippocampus* Linnaeus = *H. pentagonus* Rafinesque by absolute tautonymy.]

Hippocampus LEACH, The zoological miscellany, vol. 1, p. 103, 1814. [Genotype: *H. hippocampus* (Linnaeus) = *H. antiquorum* Leach by absolute tautonymy.]

Hippocampus CUVIER, Le règne animal . . ., vol. 2, p. 157, 1817. [Genotype: *H. hippocampus* (Linnaeus) = *Syngnathus hippocampus* Linnaeus by absolute tautonymy and by monotypy.]

Farlapiscis WHITLEY, Australian Zool., vol. 6, p. 313, 1931. (Genotype: *H. breviceps* Peters by original designation.)

The species of this subgenus that were studied form a compact group, which may be sharply distinguished from the subgenus *Macleayina* on the one hand and from *Jamsus* on the other as indicated in the key. Whether this sharp distinction will hold when the other species of seahorses are studied in detail remains to be seen.

The necessity for the new generic name introduced by Whitley is not clear, and he gives no reason for establishing it. As far as I can judge by current descriptions, *H. breviceps*, the genotype of Whitley's *Farlapiscis*, belongs to the typical subgenus *Hippocampus*.

TABLE 1.—*Frequency distribution of the number of caudal segments and fin rays in nine species or subspecies of the subgenus* Hippocampus

Species and locality	Caudal segments								Dorsal rays							Pectoral rays						
	33	34	35	36	37	38	39	40	15	16	17	18	19	20	21	13	14	15	16	17	18	19
ingens	---	---	---	---	---	2	6	2	---	---	---	---	8	2	1	---	---	2	8	1	---	---
multiannularis: Atlantic coast of Europe	---	---	---	---	---	3	9	2	---	---	---	---	5	10	1	---	---	1	5	5	3	---
guttulatus: Mediterranean coast of Europe	---	---	---	1	5	15	2	---	---	---	---	2	13	7	1	---	---	2	13	7	1	---
europaeus	---	---	---	3	3	1	---	---	---	---	1	4	3	---	---	1	3	4	---	---	---	---
hippocampus	---	1	6	3	---	---	---	---	---	1	10	---	---	---	---	2	8	1	---	---	---	---
reidi	---	1	5	3	2	---	---	---	1	1	6	1	---	---	---	---	---	4	4	1	---	---
kincaidi: Bermuda	1	1	2	2	---	---	---	---	---	---	---	4	2	---	---	---	---	1	4	1	---	---
punctulatus: Florida and Cuba	1	---	8	10	7	---	---	---	---	---	---	2	17	8	2	---	---	3	14	9	1	1
hudsonius:																						
North and South Carolina	---	---	1	7	8	1	---	---	---	---	1	8	10	1	---	---	---	4	12	1	---	---
Mississippi to Texas	---	---	1	5	10	2	---	---	---	---	---	7	9	2	---	---	---	3	11	4	---	---
Virginia to Maine	---	---	3	7	15	7	4	---	---	2	1	13	18	2	---	---	5	17	12	2	---	---

[41] See also p. 515 for a discussion of Perry's use of this generic name.

TABLE 2.—*Ranges and averages of proportional measurements of five species or subspecies of* Hippocampus *from the eastern Pacific, the eastern Atlantic, and the Mediterranean, segregated by size and sex, expressed as percentages of the length* [1]

Length (mm)	Sex	Number measured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Hippocampus ingens																
167–201	♂	2	13.4–15.4	14.4	9 – 9.5	9.3	8.9– 9.1	9.0	20– 21	20.5	31.8–31.9	31.9	64.2–65.3	64.8	3.1–3.3	3.2
118–158	♀	5	12.2–13.8	13.1	9.4–10.6	10.2	8.5– 9.9	9.3	21.9–22.7	22.2	32.3–34.4	33.4	60.2–63.2	61.6	3.4–4.0	3.7
113	♂	1	----------	13.4	----------	9.4	----------	9.5	----------	21.2	----------	33.5	----------	61.5	----------	3.9
87–95	♀	2	11.6–12.3	12.0	10.2–10.4	10.3	9.7–10.6	10.2	23 –23.9	23.5	33.1–33.2	33.2	61.6–62.2	61.9	4.2–4.5	4.4
Hippocampus guttulatus multiannularis—Atlantic coast of Europe																
101–131	♂	7	13.4–16.4	15.1	7.7–9.0	8.3	9.8–11.0	10.4	20.9–23.6	22.1	31.5–33.4	32.3	63.6–65.7	64.5	4.1–4.7	4.4
103–113	♀	7	12.0–14.1	12.9	8.1–9.2	8.4	10.1–10.9	10.6	21.7–23.6	22.5	32.5–35.2	33.4	61.7–64.0	62.9	4.4–4.8	4.6
Hippocampus guttulatus guttulatus—Mediterranean coast of Europe																
90–103	♂	6	14.4–17.4	16.1	8.5–9.2	8.9	9.3–10.1	9.8	21.4–22.7	22.0	29.7–31.9	31.0	63.3–65.8	64.6	4.2–4.9	4.6
96–110	♀	4	12.8–16.4	14.3	8.8–9.4	9.0	9.2–10.5	9.9	20.9–22.5	21.8	31.8–32.6	32.3	62.3–65.1	63.5	4.2–4.6	4.4
72–88	♂	7	12.5–16.8	14.7	8.9–9.9	9.3	9.7–10.8	10.4	22.0–24.5	23.1	31.8–33.5	32.7	62.2–64.6	63.0	4.7–5.4	5.0
78–88	♀	5	12.3–16.5	13.9	8.8–9.9	9.5	9.8–10.8	10.2	22.1–24.6	23.1	30.9–34.1	32.5	61.4–63.9	63.2	4.6–5.1	4.8
Hippocampus europaeus																
95–113	(2)	4	13.7–16.7	15.5	5.9–6.9	6.4	9.1–10.2	9.7	18.7–19.7	19.3	29.7–33.1	32.1	62.1–65.2	63.4	3.8–4.2	4.0
84–88	------	3	13.3–14.6	14.0	6.9–7.3	7.1	10.0–10.1	10.0	20.6–21.4	20.9	32.1–33.1	32.6	61.9–64	63.0	4.3–4.9	4.7

[1] For description of method of taking measurements, see pp. 507 to 509. The segregation of the material according to sex is probably not absolutely correct, as discussed on p. 510.

[2] Nearly all specimens examined either had a brood pouch or at least a rudiment of one, and the segregation of the specimens tabulated is by size only (see pp. 550 and 571).

TABLE 2.—*Ranges and averages of proportional measurements of five species or subspecies of* Hippocampus *from the eastern Pacific, the eastern Atlantic, and the Mediterranean, segregated by size and sex, expressed as percentages of the length*—Continued

Length (mm)	Sex	Number measured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Hippocampus hippocampus																
98–104	(2)	3	17.7–19.4	18.8	6.1–6.9	6.4	10.1–10.3	10.2	19.2–20.5	19.7	29.6–30.8	30.3	61.2–65.8	64.0	3.9–4.4	4.1
68–89	------	6	16.4–18.7	17.2	6.7–7.9	7.3	10.9–11.3	11.2	21.1–23.5	22.2	31.5–33.7	32.3	60.7–64.1	63.0	4.7–5.1	4.8
55	------	1	----------	15.3	---------	8.2	----------	12.0	----------	24.0	----------	34.0	----------	60.8	---------	5.5

[2] Nearly all specimens examined either had a brood pouch or at least a rudiment of one, and the segregation of the specimens tabulated is by size only (see pp. 550 and 571).

TABLE 3.—*Proportional measurements of* Hippocampus reidi *and the subspecies and populations of* Hippocampus hudsonius [1]

Length (mm)	Sex	Number measured	Depth		Snout		Postorbital		Head		Trunk		Tail		Orbit	
			Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Hippocampus reidi																
121	♂	1	----------	15.2	---------	10.0	----------	9.8	----------	22.6	----------	33.4	----------	62.2	---------	3.6
127–137	♀	2	12 –12.4	12.2	10.2–11.0	10.6	9.8–10.1	10.0	22.7–23.6	23.2	34.9–35.8	35.4	59.2–63.0	61.1	3.8–3.9	3.9
74–82	♂	2	14.1–15.2	14.7	10.2–11.2	10.7	10.5–11.0	10.8	24 –26.5	25.3	34.3–36.2	35.3	59.2–61	60.1	4.3–4.8	4.6
58–93	♀	2	13.3–15.1	14.2	11.7–12.7	12.2	11.4–12.1	11.8	26.9–27.1	27	35.8–35.9	35.9	58.5–59	58.8	4.6–5.2	4.9
46	♂	1	----------	11.3	---------	11.7	----------	11.1	----------	26.5	----------	37.4	----------	56.5	---------	5.7
50	♀	1	----------	12	---------	10	----------	11.8	----------	26.4	----------	38.6	----------	55.6	---------	6.0

Hippocampus hudsonius kincaidi—Bermuda																
118	♂	1	----------	18.6	----------	8.1	----------	10.3	----------	22.3	----------	32.6	----------	65.6	----------	4.5
75–88	♂	3	16.2–18.9	17.8	8.7–9.9	9.2	9.8–10.6	10.1	20.4–24.8	22.6	32.0–33.2	32.6	62.7–63.2	62.9	4.6–5.2	4.9
61–62	♀	2	13.9–14.0	14.0	9.8–10.3	10.1	10.5–10.8	10.7	25.0–25.1	25.1	37.2–37.6	37.4	58.4–59.8	59.1	4.9–5.3	5.1
Hippocampus hudsonius punctulatus—Florida and Cuba																
100–162	♂	8	19.9–22.1	20.7	8.4–10.9	9.9	10.1–11.3	10.9	22.0–26.4	24.2	33.0–36.8	34.8	59.2–62.7	61.3	3.9–4.7	4.2
92–142	♀	7	18.1–20.1	19.1	9.3–11.3	10.2	10.4–12.2	11.4	23.3–26.4	24.7	34.7–36.6	35.8	58.7–61.7	59.7	3.7–4.7	4.3
60–91	♂	2	15.4–16.3	15.9	10.7–12.1	11.4	11.4–12.7	12.1	27.0–27.5	27.3	35.8–36.3	36.1	56.5–57.0	56.8	4.4–5.8	5.1
49–60	♀	5	12.7–16.0	14.4	10.2–12.3	11.2	10.7–12.9	11.6	24.9–29.2	27.0	33.7–38.7	36.5	54.7–58.4	56.0	5.1–5.8	5.3
Hippocampus hudsonius hudsonius—North and South Carolina																
98–102	♂	2	18.0–18.3	18.2	8.0–8.0	8.0	9.8–10.6	10.2	21.0–22.3	21.7	29.8–31.5	30.7	64.4–65.3	64.9	4.2–4.4	4.3
96–110	♀	5	15.3–18.9	17.4	7.7–10.0	9.2	10.8–11.3	11.0	21.6–24.5	23.6	32.9–34.9	34.2	58.8–62.4	60.2	4.2–5.4	4.6
70–88	♂	5	15.0–19.3	16.9	7.4–9.4	8.2	10.0–11.4	10.8	20.7–23.9	22.5	30.7–33.8	31.9	61.5–64.4	63.1	4.3–5.6	4.9
48–70	♀	3	12.7–16.2	14.6	7.9–12.5	10.2	10.6–11.8	11.1	22.9–27.5	25.2	33.3–36.0	34.3	57.3–62.4	60.4	4.7–5.2	4.9
Hippocampus hudsonius hudsonius—Mississippi to Texas																
98–130	♂	6	18.1–20.3	19	7.7–8.7	8.2	10.0–11.2	10.5	20.9–23.3	22.5	31.3–33.1	32.1	62.0–65.0	64.1	3.8–4.8	4.1
116	♀	1	----------	17.2	----------	8.1	----------	10.3	----------	21.2	----------	35.3	----------	62.0	----------	4.3
58–81	♂	5	15.9–18.7	16.8	8.1–9.8	9.0	10.9–12.6	11.6	23.4–25.9	24.1	32.5–35.3	33.7	58.6–62.8	60.8	3.9–5.3	4.6
48–79	♀	4	13.3–16.6	14.6	8.9–10.0	9.6	10.4–11.5	11.1	24.4–25.4	24.9	32.5–36.0	34.2	58.7–61.9	60.4	4.5–5.6	5.2
43	♂	1	----------	15.4	----------	10.9	----------	12.3	----------	27.9	----------	36.5	----------	56.8	----------	6.5
42	♀	1	----------	10.6	----------	10.1	----------	12.0	----------	26.5	----------	34.7	----------	58.8	----------	6.3
Hippocampus hudsonius hudsonius—Virginia to Maine																
95–150	♂	9	16.3–20.3	18.4	7.0–8.3	7.8	9.9–11.2	10.3	20.2–22.4	21.2	29.6–35.8	32.7	61.7–66.7	63.7	3.6–4.7	4.1
80–95	♀	6	13.4–17.1	15.5	8.3–10.6	9.3	9.7–11.3	10.3	21.8–24.2	22.8	33.0–35.9	34.2	57.8–63.0	60.4	4.0–4.8	4.4
50–70	♂	5	14.3–17.0	15.6	7.7–9.3	8.4	10.5–12.3	11.3	21.8–26.5	23.4	31.4–34.9	33.0	60.2–63.9	62.0	4.9–5.9	5.2
56–68	♀	6	13.3–15.6	14.5	7.7–11.6	8.9	10.2–12.0	11.1	21.8–24.6	23.4	32.2–33.8	33.5	58.8–61.6	60.8	4.4–5.5	5.0

[1] See footnote 1 to table 2.

HIPPOCAMPUS INGENS Girard

FIGURE 55

Hippocampus ingens GIRARD, *in* Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, vol. 10, pt. 4, Fishes, p. 342, 1859. (San Diego, Calif.)

Hippocampus gracilis GILL, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 283. (Cape St. Lucas, Calif.)

Hippocampus ingens JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 776, 1896. (*H. gracilis* placed in synonymy of *ingens*.)

Hippocampus ecuadorensis FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 446, fig. 2, 1921. (Bahia, Ecuador.)

Hippocampus ingens MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 256, 1923. (Chame Point and Panama City market, Panama.)

Diagnosis.—First caudal segment hexangular[42] (in 10 specimens studied, injured in one); last trunk segment octangular; penultimate trunk segment septangular or novemangular (completely septangular in four and novemangular in four, incompletely novemangular in two); antepenultimate and the preceding trunk segments septangular. In other words, an extra plate on first caudal and last one or two trunk segments; or, upper ridges of tail and trunk overlapping on two or three segments. Trunk segments usually 11 (in seven), sometimes 12 (the twelfth segment complete in one specimen, incomplete[43] in two; all these three specimens having the penultimate trunk segment with an extra plate). Caudal segments 38 to 40. Dorsal rays modally 19, varying 19 to 21. Pectoral rays modally 16, varying 15 to 17. Tubercles well developed in medium-sized fish, usually pointed, sometimes rather stubby but high; becoming almost obliterated in largest males, somewhat better developed in large females. Coronet of medium height in medium-sized fish of both sexes and in large females, somewhat lower in large males. Trunk notably slender; snout long. Filaments very few and rather short (present only in the medium-sized specimens examined). Profusely covered with many small rounded brown spots, somewhat as in *reidi;* small whitish or silvery dots often unusually profuse, characteristically tending to an arrangement into irregular rows and often tending to coalesce into fine white streaks irregularly spreading over nearly entire tail, trunk, and head. Dorsal with a submarginal dark streak typically present, often obscure; margin over dark streak hyaline, more or less dusky or diffusely spotted below the streak; sometimes entire dorsal nearly colorless. (For counts and measurements see tables 1 and 2.)

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[42] For a discussion of the modification in the structure of the first caudal and posterior trunk segments in the species of *Hippocampus* and of the various ways in which this modification may be expressed, see pp. 505 to 507.

[43] See p. 504 for explanation of an incomplete trunk segment.

FIGURE 55.—*Hippocampus ingens*, drawn from a male, 201 mm long, from Panama; U.S.N.M. no. 79683. Length of specimen as drawn, 127 mm. (The latter stated length in this and other figures refers to the distance between two horizontal lines forming the boundaries of the specimen as drawn, a tangent through the outermost coil in the tail and a horizontal through the uppermost point on the head or "neck.")

Distinctive characters and relationships.—In practice no difficulty will be found in identifying specimens belonging to this species. Only one other species, *hildebrandi*, is now known to occur within the range of *ingens*. The differences between the two are discussed under the account of *hildebrandi* (p. 579), which is saliently distinct from *ingens*.

This species differs from all others of its subgenus treated herein in its large size and in the fact that the upper ridges of the tail and trunk overlap on three segments as often as on two, possibly even oftener on three, whereas in the other species the normal overlap is on two segments with an overlap on three as a rather infrequent individual variation. In this respect *ingens* forms a transition between *Hippocampus* proper and the subgenus *Macleayina*.

While there is no doubt that *ingens* is quite distinct and no author ever questioned its distinctive nature, it is remarkable that it shows no structural characters by which it may be sharply delimited from some other American or European species of *Hippocampus*, which possibly are not even closely related to it. This furnishes an illustration of the difficulties encountered in properly distinguishing the species of *Hippocampus* by the ordinary morphological methods. In its slender body, long snout, color pattern, and tendency for the tubercles to become obsolescent with age it closely approaches or agrees with *reidi*, differing in having more numerous caudal segments and dorsal rays; but the two species closely approach each other in those characters even in the comparatively few specimens studied. When a large specimen of *reidi* is compared with specimens of *ingens* of similar size—specimens of such length may be considered to be only of medium size in *ingens*—the former appears markedly different on account of its obsolescent tubercles; but in full-grown specimens of *ingens* the tubercles on the trunk also become rather obsolescent, especially in full-grown males.

As far as the structural characters are concerned, *ingens* is even nearer to *guttulatus* from the Mediterranean, or *multiannularis* from the Atlantic coast of Europe, closely agreeing with those two subspecies in the number of caudal segments, pectoral rays, and dorsal rays and being nearer to the former in its dorsal rays and nearer to the latter in its caudal segments. It differs from both in having a longer snout and, on the average, a slenderer body and a characteristic profusion of small dark spots. The length of the snout possibly will also be found to intergrade when larger series are measured. It is also closely related to *hudsonius* from the Atlantic coast of North America, *ingens* differing chiefly in the color pattern, but in structural characters the two species more or less overlap, although the averages or frequency distributions are decidedly different. While *ingens*, in general, differs from *hudsonius* in its structural characters in approxi-

mately the same manner as it differs from *guttulatus* or *multiannularis*, in the frequency distribution of its meristic characters it is nearer to the European species than to the American *hudsonius* (see table 1). As stated, it differs from *hudsonius*, *guttulatus*, *multiannularis*, *reidi*, and others in tending strongly to have an extra plate on the penultimate trunk segment, and as a consequence the upper ridges of the tail and trunk overlap on three segments about as often as on two, or, in other words, the penultimate segment is novemangular nearly as often as septangular. Quite likely this character is an important and suggestive indicator of phylogenetic relationship, in spite of the fact that it is shown only by half, or slightly more than half, of the population.

Material examined and geographic distribution.—San Diego, Calif.; A. Cassidy; four cotypes (982).[44] Mazatlan, Mexico; J. G. Ortega (86239). Chame Point, Panama; March 8–14, 1913; R. Tweedlie (82038). Panama City market; Meek and Hildebrand (79682, April 1912; 79683, 1912; 79684, March 22, 1912). Panama Bay, lat. 7°57′ S., long. 78°55′ W.; March 5, 1888, *Albatross* (43404). Salinas, Ecuador; September 17, 1926; Dr. Waldo L. Schmitt (88833, in bad condition but evidently the present species).

Total number of specimens studied, 11; three with a brood pouch, 113 to 201 mm long, seven without any trace of a brood pouch, 87 to 158 mm (one specimen broken, sex and length indeterminable). The localities from which specimens were examined represent a range from San Diego, Calif., to Salinas, Ecuador.

Synonymy.—I follow previous authors in placing *H. gracilis* in the synonymy of *ingens*, although the original description is not sufficiently detailed to be certain of such reference. Since the type is evidently lost this is probably the best course to take, unless another species turns up from that region. The account of *H. ecuadorensis* shows that it was apparently based on a specimen of *ingens*. Fowler states that his new species "differs from *H. ingens* in more dorsal rays, larger eye, blunt body and tail rings, and the absence of dermal flaps." The 11 specimens examined have 19 to 21 dorsal rays, and it is consequently reasonable to expect that 22 rays, as in the type of *ecuadorensis*, falls within the range of variation; the blunt rings and the absence of dermal flap are usual in large specimens. The size of the eye is too variable to be employed by itself in distinguishing species. The color pattern, as indicated by the description and figure, is typical of *ingens*.

[44] Unless otherwise specified, the numbers given in parentheses throughout this paper are U. S. National Museum catalog numbers. Data without numbers refer to specimens in the U. S. Bureau of Fisheries.

FIGURE 56.—*Hippocampus guttulatus multiannularis*, new subspecies, drawn from a paratype; Univ. Michigan Mus. no. 111748, 110 mm long. Length of specimen as drawn, 63 mm. The long appendages are fleshy filaments, not spines.

FIGURE 57.—*Hippocampus guttulatus multiannularis*, new subspecies, drawn from a female paratype 113 mm long. Length of specimen as drawn, 62 mm.

HIPPOCAMPUS GUTTULATUS MULTIANNULARIS, new subspecies

FIGURES 56, 57

Hippocampus atrichus DE LA PYLAIE, Congr. Sci. France, Poitiers, 1834, 2d sess., p. 528, 1835 (see p. 524).

Hippocampus antiquorum DAY (not Leach), The fishes of Great Britain and Ireland, vol. 2, p. 265, pl. 144, fig. 7, 1880 (the figure has a rather long snout and was probably drawn from a specimen of the present subspecies).

Hippocampus guttulatus DUNCKER (not Cuvier, as here restricted, see p. 546), Die Tierwelt der Nord- und Ostsee, pt. 12g, p. 23, 1926 (the description and the figure agree fairly well with the present subspecies, and if that account includes Atlantic coast specimens they should probably be referred to it).

Diagnosis.—First caudal segment hexangular and last trunk segment octangular (in all 16 specimens examined); antepenultimate segment nearly always septangular (incompletely novemangular in only one of the 16 specimens examined). In other words, nearly always extra plates on first caudal and last trunk segments only; or upper ridges of tail and trunk overlapping on two segments only (with the single exception noted). Trunk segments 11 (in all 16 specimens examined). Caudal segments modally 39, varying 38 to 40. Dorsal rays usually 19 or 20, varying 19 to 21. Pectoral rays oftenest 16 or 17, varying 15 to 18. Tubercles rather low but conspicuous. Coronet of medium height, preceded by a double bony hump of nearly same height and almost fused with it, producing the effect, when viewed from the side, of an unusually wide and comparatively low coronet. Trunk rather slender, snout of medium length. Most specimens, both males and females, with a few short filaments on coronet and postorbital spines, sometimes also a few on anterior spines of upper ridge of trunk. Specimens having the color fairly well preserved nearly uniformly colored, rather dark, profusely sprinkled with small white dots, comparatively coarse, especially on head and trunk, sometimes a few white dots coalescing there to form elongate spots or short irregular lines. (See tables 1 and 2 for counts and measurements.)

Distinctive characters and relationships.—As already noted, the common seahorses occurring on the Atlantic coast of Europe have hitherto been generally regarded by authors as belonging to one species and referred to either one or the other of the two common Mediterranean species. If the locality of the specimens forming the basis of the present account is correct, however (see p. 541), it shows that on the coasts of Europe two common species occur in the Atlantic as well as in the Mediterranean. The two European Atlantic coast seahorses may be distinguished chiefly by the correlation of a shorter snout and fewer caudal segments in one, while the other has a longer snout in combination with more numerous caudal segments. The apparent reason for the prevalent "opinion" that only one species

exists on the Atlantic coast is the greater difficulty of distinguishing the two forms occurring there, while the two Mediterranean species are more readily distinguishable and were consequently recognized by nearly all more recent authors.

The Atlantic short-snouted seahorse differs specifically from the short-snouted Mediterranean species and is treated herein under the name of *H. europaeus*. The other Atlantic seahorse is rather long-snouted and is apparently specifically identical with the long-snouted Mediterranean species, *guttulatus*, but the Atlantic coast population diverges sufficiently to be recognized as a distinct subspecies and is here described as *multiannularis*.

The differences between the subspecies *guttulatus* and *multiannularis* may be readily appreciated by a study of tables 1 and 2. It will be noted that *multiannularis* has a distinctly higher caudal segment count, the mode being at 39 instead of 38. To a lesser extent it also averages a higher dorsal ray count and possibly a higher pectoral ray count. In proportional measurements *multiannularis* has, on the average, a slenderer trunk, a slightly shorter snout, a rather longer postorbital distance, and a slightly longer trunk and shorter tail, although there are usually more tail segments. The white spots in *multiannularis* are usually somewhat coarser and more numerous. The tubercles and coronet are perhaps not so well developed as in *guttulatus*, but these structures vary greatly with age, and their variations in both subspecies remain to be established more definitely. The two subspecies differ somewhat as *hudsonius* and *punctulatus* differ on the American coasts.

The difference between *multiannularis* and its congener occurring in the same region, *europaeus*, may also be gathered by a study of tables 1 and 2, *europaeus* saliently differing in having fewer caudal segments and dorsal and pectoral rays and a shorter snout, but the exact degree of divergence between the two Atlantic seahorses remains to be determined. Out of 24 specimens examined, representing both forms, all were readily referred to their proper species or subspecies, except one somewhat doubtful specimen, which is described in some detail on page 542.

Material examined and geographic distribution.—The origin of the specimens on which the foregoing account is based is to some extent uncertain and is here explained in detail. Dr. Carl L. Hubbs kindly sent me a lot of 20 seahorses from the collection of the Michigan University Museum of Zoology for study, three of them more or less damaged, the other 17 in fair or good condition. This lot was originally kept alive on exhibition in the New York Aquarium and according to Dr. Hubbs came "supposedly from the Bay of Biscay." In order to trace their origin more definitely I wrote to C. M. Breder, Jr., associate director of the New York Aquarium, who replied that

the seahorses were presented to the aquarium by E. O. Freund, of Chicago, that Mr. Freund purchased the specimens from Dagry Frères of Paris, and that they were said to have been caught in the Bay of Biscay. I then wrote to Dagry Frères, who replied as follows: "Tous les cheveaux marins qui sont fournis par notre Maison proviennent du Bassin d'Arcachon dans l'Océan Atlantique." A detailed study shows that irrespective of whether the specimens from Dagry Frères were mixed with those from other sources somewhere along the line of transfer from one party to the other (see next paragraph), it is highly probable that 16 came from the Bay of Biscay. At any rate, there is hardly any question that all 16 belong to one subspecies, which is most closely related to *guttulatus*, and that they are subspecifically distinct from typical *guttulatus* from the Mediterranean.

One of the specimens in the lot possibly did come from another source. It is apparently a *hippocampus*, a Mediterranean species. This specimen is discussed at greater length on page 572.

Briefly, the present subspecies is based on eight specimens with a brood pouch, 101 to 131 mm long, and eight without a brood pouch, 103 to 113 mm long (one male and one female with the tail broken off at the end, the female possibly somewhat longer than the largest female with an unbroken tail). The locality of capture, Bay of Biscay, while apparently correct, needs to be verified. The difference in geographical distribution between *multiannularis* and the typical subspecies of *guttulatus* remains to be worked out.

Holotype.—Univ. Michigan Mus. no. 111747; the brood pouch of medium development; caudal segments 40, dorsal rays 20; pectoral rays 18; length 108 mm; depth 15.5, snout 9, postorbital 11, trunk 33, tail 63.5 and orbit 4.5 percent of length (these measurements and counts are included in the tables and in the foregoing diagnosis). The locality of the type indicated above.

Paratypes.—Univ. Michigan Mus. no. 111748; 15 specimens in same lot with the type.

Uncertain specimen.—A single specimen (93733), somewhat doubtfully referred to *multiannularis*, may be described as follows: Without a brood pouch; trunk segments 11, caudal segments 39, dorsal rays 20, pectoral rays 16; length 130 mm, depth 13, snout 7.5, postorbital 11.5, head 21, trunk 33 and tail 63 percent of length. When these data are compared with tables 1 and 2, it will be noted that the counts of the meristic characters are more as in *multiannularis*, but possibly the specimen represents an extreme variant of *europaeus*. The length of the snout is rather intermediate between the specimens of *europaeus* and *multiannularis* that were measured, but nearer to the latter. Moreover, it is a large specimen, and the relative length of

the snout decreases with size; consequently, it is more likely that this specimen represents a *multiannularis*. The depth, and length of the head, are also somewhat nearer to *multiannularis*. It is one of a lot of three originally carried in the United States National Museum as no. 16454, with the locality entered as "England" with a question mark. The two smaller specimens in this lot are entirely typical of *europaeus* and are included here in the account of that species, but the specific relation of the present specimen is somewhat uncertain for the reasons stated, and is treated here separately. It may be possible to place this specimen with greater assurance after the range of variation of both species is more definitely determined by a study of larger numbers of specimens.

HIPPOCAMPUS GUTTULATUS GUTTULATUS Cuvier

Hippocampus non aculeatus, incisuris raris WILLUGHBY, Historia piscium . . ., Tab. I 25, fig. 4, 1686 (no definite locality indicated, restricted by Cuvier, 1817, to a species from "nos mers" and Cuvier's account later formed basis of Schinz's *longirostris*).

Syngnathus hippocampus BLOCH (in part), Naturgeschichte der ausländishen Fische, pt. 1, p. 7, pl. 109, fig. 2, 8 ed., 1786 (the figure and only part of written account apparently refer to this species).

Hippocampus ramulosus LEACH, The zoological miscellany, vol. 1, p. 105, pl. 47, 1814 (locality unknown; possibly based on a specimen of the present subspecies, see p. 518).

Hippocampus ["a museau plus long"] CUVIER, Le règne animal . . ., vol. 2, p. 157, 1817 ("nos mers"; refers to Willughby's figure 4; distinguished but not named).

Hippocampus longirostris SCHINZ, Das Thierreich von Cuvier, vol. 2, p. 262, 1822 (based on Cuvier's preceding account; herewith formally restricted to the Mediterranean population).

Hippocampus rosaceus RISSO, Histoire naturelle des principales productions de l'Europe méridionale . . ., vol. 3, p. 184, 1826 (most likely refers to present subspecies, see p. 521).

Hippocampus guttulatus CUVIER, Le règne animal . . ., ed. 2, vol. 2, p. 363, 1829 (evidently a substitute for *longirostris* Schinz, generally employed by authors to designate the common Mediterranean long-snouted seahorse and herewith formally restricted to the Mediterranean population).

Hippocampus ramulosus GÜNTHER, Catalogue of the fishes of the British Museum, vol. 8, p. 201, 1870 (account includes type of *ramulosus*).

Hippocampus guttulatus RAUTHER, Die Syngnathiden des Golfes von Neapel, p. 8, pl. 2, figs. 12, 14, 15, 1925 (the figure 13 is not typical of the present species, having the spines too low, the snout intermediate, and the color more as in *H. hippocampus;* Rauther gives an extensive account of the biology and anatomy of the Mediterranean species).

Diagnosis.—First caudal segment hexangular, last trunk segment octangular, and penultimate segment septangular (constant in all 24 specimens examined). In other words, first caudal and last trunk segment only bearing extra plates for support of the dorsal; or, upper ridges of tail and trunk overlapping on two segments. Trunk seg-

ments 11 (in all 24 available specimens). Caudal segments modally 38, varying 36 to 39. Dorsal rays modally 19, varying 18 to 21. Pectoral rays modally 16, varying 15 to 18. Spines on upper ridge of trunk fairly well developed in full-grown fish, only slightly better developed in female. Coronet fairly well developed; a humplike bony elevation preceded by a spinelike tubercle in front of coronet, the spine often becoming obsolescent, producing an effect of a double hump, the latter usually fairly discontinuous and separated from coronet, often nearly fused and having the effect of a very broad coronet when viewed laterally (resembling then that of *multiannularis*, see p. 540). Trunk of medium depth; snout of medium length. Filaments present in some of the specimens examined, relatively not numerous, sometimes rather long (many long filaments shown on one of Rauther's figures). Color (somewhat faded in the material examined) more or less profusely peppered with white dots; somewhat coarser, in form of very small white spots, on side of trunk and opercle; often coalescent there to form short, somewhat irregular elongate spots or white lines showing a tendency to a vertical arrangement on trunk and on opercle. Dorsal with a dark submarginal band, dusky below but of a lighter shade than the band. (See tables 1 and 2 for counts and measurements.)

Distinctive characters and relationships.—*H. guttulatus* is composed of two subspecies, the typical subspecies in the Mediterranean, and a second subspecies, *multiannularis*, on the Atlantic coast, which has already been described. The difference between the two is discussed on page 541.

The subspecies *H. guttulatus* may be readily distinguished from the other common seahorse occurring within its range, *H. hippocampus*, by its more numerous caudal segments and dorsal and pectoral rays and by its longer snout and slenderer trunk. All these characters are discontinuous or nearly so (see tables 1 and 2), and there should be no trouble in properly placing even individual fish. Furthermore, these differences are reinforced by *guttulatus* having notably better developed tubercles and a different color pattern, consisting of white dots and spots against a darker nearly uniform background, instead of the typical dark spots against a lighter background in *hippocampus*.

H. guttulatus is close to *hudsonius* from the American coast. In fact, as far as the structural characters are concerned, they may well be regarded as subspecies. The greatest divergence between *guttulatus* and *hudsonius* is in the average greater number of caudal segments in the former, but there is much intergradation between the two (see table 1). The trunk in *guttulatus* averages somewhat slenderer, and there are other smaller differences (see tables 1 to 3). *H. guttulatus*, too, shows some color peculiarities. It has neither the brown lines on the trunk and opercle, which are characteristic of the full-grown *hudsonius* and its subspecies *punctulatus* and *kincaidi*, nor the

large blotches on the trunk, which are especially developed in medium-sized and often persist in large specimens of these American seahorses. The white dots on the trunk of *hudsonius* are very sparse and of the same small size as those on the tail, while in *guttulatus* the white spots on the side of the trunk are characteristically larger than those on the tail, are quite profuse, and tend to coalesce, forming somewhat irregular short lines or elongate spots. Because of the different color pattern in combination with the structural differences and their widely discontinuous distribution, *hudsonius* and *guttulatus* are recognized as independent species rather than subspecies.

H. hudsonius is nearer in the average number of caudal segments, the most divergent character, to the typical *guttulatus* from the Mediterranean than to its subspecies *multiannularis* from the Atlantic coast of Europe. Consequently, it is quite possible that *hudsonius* and *guttulatus* are not so closely related as the specific characters investigated during this study would indicate. Attention has been called to the remarkable similarity in structural character between *guttulatus* and *ingens* (see p. 536), although there is no question as to the distinctness of these two species.

Material studied and geographic distribution.—Adriatic Sea; J. Smolinsky (44438, more definite locality not given). Venice; D. S. Jordan (23427 and 34356). Sicily (21164). Naples (21121 and 28550). Bay of Naples; S. E. Meek; April 1897 (48326). Genoa; D. S. Jordan (29732). Europe (93744; five specimens, more definite locality not given, but without doubt belonging to present subspecies).

Total number of specimens examined, 24, nine without a brood pouch, 78 to 110 mm long, 15 with a brood pouch or at least a rudiment of one, 72 to about 110 mm long (the largest male dried and accurate length not determinable).

The material examined comprises localities ranging from Venice to Genoa (see also discussion of specimen from Greece, p. 546). From accounts in the literature, and from the material examined, it seems evident that this subspecies is widely distributed and common on the northern coast of the Mediterranean, including the Adriatic Sea, but its more precise geographical limits still remain to be worked out. At least some of the records of "*guttulatus*" from the Atlantic coast of Europe refer to the new subspecies here described as *multiannularis;* while extant records of "*guttulatus*" from other places no doubt refer to various other species.

Nomenclature and synonymy.—Because of its markedly longer snout and other salient differences as compared with the other common seahorse on the northern coast of the Mediterranean, the subspecies *guttulatus* appears to have been correctly distinguished from *hippocampus* by nearly all authors, and Cuvier's name *guttulatus* has been employed most generally to designate it. Cuvier, however, was

anticipated by Schinz and possibly by two other previous authors. The name *longirostris* Schinz, 1822, certainly, and possibly *ramulosus* Leach, 1814, and *rosaceus* Risso, 1826, if the last two were based on specimens of the same species, have priority over *guttulatus* Cuvier, 1829. According to the strict application of the rules the later name *guttulatus* should be suppressed. Nevertheless, since it has become so well established general usage is here followed and the name *guttulatus* continued. This course is more expedient also for two reasons: (1) The proper application of the name *ramulosus*, which has priority over *longirostris*, must remain uncertain until the type is reexamined, and (2) a name earlier even than *ramulosus* may be discovered as applying to the form. While I attempted to examine and review all the early publications bearing on the nomenclature of the seahorses, it is quite possible that I missed some pertinent publication. As a matter of fact, I came across Schinz's name *longirostris*, which has been left out of all general lists, by mere chance. Further search may reveal a still earlier designation for this species, which would necessitate another change of name. Therefore, the use of the well-established name *guttulatus* is continued.

As stated previously, my study has shown that the populations of this species from the Atlantic and from the Mediterranean coasts are subspecifically distinct. Consequently, it becomes necessary to restrict further the application of the early names, and the name *longirostris* Schinz, as well as the later substitute name *guttulatus*, has been formally restricted to the Mediterranean population (see p. 525).

Uncertain specimen.—A single specimen in bad condition from Greece (45041) probably belongs to this subspecies. The dorsal and pectoral are injured and the number of rays cannot be accurately determined. Trunk segments 11, caudal segments 38, the two upper ridges overlapping on two segments; without a brood pouch; length 91 mm; depth 13, snout 11, postorbital 11, head 25.3, trunk 32.7, tail 63, and orbit 5.3 percent of length. From table 2 it may be noted that these measurements agree fairly well with *guttulatus* except in the unusually long snout. This may represent an extreme variant in that respect, or it may have some taxonomic significance, a question to be determined only by a study of more numerous specimens from Greece. It is possible that *guttulatus* is divisible into distinct populations, as are *hudsonius* or *zosterae* (see under their accounts).

HIPPOCAMPUS EUROPAEUS Ginsburg

FIGURE 58

Hippocampus brevirostris YARRELL (not Schinz, 1822), A history of British fishes, vol. 2, p. 452, 1836 (England; the rather short snout shown by the figure indicates that the account is probably based on the present species).

Hippocampus europaeus GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 561, 1933 (La Rochelle).

Diagnosis.—First caudal segment hexangular and last trunk segment octangular (in all eight specimens examined); penultimate trunk segment usually septangular, often novemangular (completely

FIGURE 58.—*Hippocampus europaeus*, drawn from the type, a male 95 mm long from La Rochelle, France U.S.N.M. no. 28544. Length of specimen as drawn, 55 mm. Color faded.

septangular in five and novemangular in two, incompletely novemangular in one). In other words, an extra plate always present on first caudal and last trunk segment, often also on penultimate trunk

segment; or, upper ridges of tail and trunk usually overlapping on two segments, often on three. Trunk segments usually 11 (in six), sometimes 12 (in the two specimens noted above as having the penultimate trunk segment completely novemangular). Caudal segments usually 36 or 37, varying 36 to 38.[45] Dorsal rays usually 18 or 19, varying 17 to 19. Pectoral rays usually 14 or 15, varying 13 to 15. Tubercles on upper ridge of trunk conspicuous, but rather short, intermediate in development between *guttulatus* and *hippocampus*. Coronet variable, medium to rather low, double bony hump in front of it usually lower than and distinctly not continuous with it. Trunk of medium depth; snout conspicuously short. Available specimens without any filaments. Color faded in available specimens, traces of white elongate spots or short lines on opercle and trunk of two specimens. (See tables 1 and 2 for counts and measurements.)

Distinctive characters and relationships.—*H. europaeus* is likely to be confused with *multiannularis*, which occurs in the same region with it, and the two have apparently been so confused by most authors. The difference between them has been pointed out under the account of the latter (p. 541). This species is also near to *hippocampus* from the Mediterranean, agreeing with it in the short snout but differing in having more numerous caudal segments and dorsal rays, a slenderer body (see tables 1 and 2), and conspicuously better developed tubercles. In the two meristic characters they intergrade, but in the relative depth there are no intergradients in the specimens measured, although such may be found when larger numbers are measured. The range of variation of each species and the relation between *europaeus* and *hippocampus* still remain to be determined. It is possible that their geographic ranges overlap and that in the region where both occur some difficulty may be found in referring occasional specimens to their proper species (see discussion of uncertain specimen on p. 572).

H. europaeus is even nearer, in its structural characters, to *hudsonius* from the American coast, especially to its northern population, than to any European species or subspecies. It differs chiefly from *hudsonius* in having a shorter snout, and to a lesser extent in a slenderer trunk and fewer pectoral rays; but in the latter two characters there is more or less intergradation (see table 1 and compare tables 2 and 3). The typical color pattern of *europaeus* is apparently

[45] In the brief description of the type specimen I stated that it has 39 caudal segments. A reexamination of the specimen after I gained considerably more experience in counting the caudal segments shows that 38 is probably the correct number, but it is difficult to determine with absolute accuracy whether it has 38 or 39 unless the specimen is to be dissected. Since what appears to be the last segment is slightly longer than usual, it was thought to represent two segments. However, according to the method herein employed in counting the segments, it should be recorded more properly as having 38 caudal segments (see p. 504).

nearly the same as in *guttulatus* and unlike that of *hudsonius* (see discussion on p. 544), but in the available specimens of *europaeus* the color is not sufficiently well preserved to determine this difference more definitely.

The relationship of *europaeus* to the other species and subspecies of *Hippocampus* nearest it is quite obscure and may be interpreted in more than one way, depending on the assumption made at the start. In its short snout *europaeus* agrees closely with *hippocampus* from the Mediterranean, but in the counts of the caudal segments and dorsal and pectoral rays, as well as in the relative development of the tubercles, it is about intermediate between *hippocampus* and *multiannularis*. If we assume that *europaeus* is the more primitive form, it may follow that *hippocampus* and *multiannularis* diverged from it in different directions, one in the direction of having fewer fin rays and caudal segments and the other in the direction of having higher counts of the same characters. Also, *hippocampus* diverged in the direction of the tubercles becoming obsolescent, retaining the primitive condition of the short snout of the parent species; while *multiannularis* diverged in the direction of an increasing length of snout and a better development of the tubercle.

Again, we may assume that *multiannularis* is the more primitive form and argue that *europaeus* diverged from it in the direction of a diminishing number of segments and fin rays, a decreasing prominence of the tubercles, and a decreasing length of snout. As a further intensification of this same developmental tendency, it may be argued that *hippocampus* developed from *europaeus*. Or we may assume that *hippocampus*, or *guttulatus*, or *hudsonius* from the American coast is the more primitive form. In fact, each assumption will lead us to a different interpretation of the close relationship of these species and subspecies. The apparent relationship of *europaeus* to *guttulatus*, to *hudsonius*, and to *hippocampus* seems to indicate that *europaeus* is the more primitive form and that with it as a focal center the other three species diverged in different directions, but the evidence does not justify the unquestioned acceptance of this.

Marked features of *europaeus* are the decided tendency shown by the penultimate trunk segment to have an extra plate on top and the frequency of occurrence of 12 trunk segments. These features are shown also by *ingens* and to a much more pronounced degree than by *europaeus*. They also may indicate a more primitive condition.

Material studied and geographic distribution.—La Rochelle, France (28544, the type; 93217 and 21122). Also two specimens without certain locality but evidently belonging to *europaeus* (16454); they

are recorded in the National Museum as coming from "England" but with a question mark. A third and larger specimen of the same lot agrees more nearly with *multiannularis* and is described above (p. 542); it is the only specimen out of a total of 25 examined from the Atlantic coast of Europe the relationship of which is in doubt, whether it belongs to the present species or to *multiannularis*.

FIGURE 59.—*Hippocampus hudsonius hudsonius*, drawn from a specimen about 7 mm long from coast of North Carolina

Total number of specimens examined, 8, 84 to 113 mm long (tail in one specimen broken and its length unknown but evidently falling within the given range of lengths). Since *europaeus* obviously has been confused with other species, the only definite locality to which it may be assigned must be based on the material examined, namely, La Rochelle, and its precise geographical distribution still remains to be determined. All the specimens examined had either a fully developed brood pouch or at least a rudiment of one represented by an oval fold of skin or an oval pigmented area under the anterior part of the tail. It is possible therefore, that in *europaeus*, as in *hippocampus*, this structure does not definitely indicate the sex (see p. 510).

HIPPOCAMPUS HUDSONIUS HUDSONIUS De Kay

FIGURES 59–62

Hippocampus hudsonius DE KAY, Zoology of New York, pt. 4, Fishes, p. 322, pl. 53, fig. 171, 1842 (New York).

Hippocampus laevicaudatus HECKEL, *in* Kaup's Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 16, pl. 2, fig. 2, 1856 (North America).

Hippocampus hudsonius YARROW, Proc. Acad. Nat. Sci. Philadelphia, vol. 29, p. 204, 1877 (Fort Macon, N. C.).

Hippocampus antiquorum GOODE (not Leach), Proc. U. S. Nat. Mus., vol. 1, p. 45, 1878 (St. Georges Banks).

Hippocampus antiquorum GOODE and BEAN, Amer. Journ. Sci., ser. 3, vol. 17, p. 39, 1879; also in Bull. Essex Inst., vol. 11, no. 1–3, p. 4, 1879 (Georges Bank, possibly refers to same specimen as preceding record).

Hippocampus hudsonius JORDAN and GILBERT, U. S. Nat. Mus. Bull. 16, p. 907, 1882 (Beaufort, N. C.).

Hippocampus punctulatus BEAN (not Guichenot), Bull. U. S. Fish Comm., vol. 7, p. 134, 1889 (Ocean City and Somers Point, N. J.).

Hippocampus hudsonius JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 777, 1896 (*laevicaudatus* placed in synonymy of *hudsonius*).

Hippocampus hudsonius SMITH, The fishes of North Carolina, p. 172, fig. 67, 1907 (Beaufort, N. C.).

Hippocampus punctulatus SMITH (not Guichenot), ibid., p. 173 (Beaufort, N. C.).

Hippocampus hudsonius EVERMANN and HILDEBRAND, Proc. Biol. Soc. Washington, vol. 23, p. 160, 1910 (Cape Charles City).

Hippocampus hudsonius HILDEBRAND and SCHROEDER, Bull. U. S. Bur. Fish., vol. 43, pt. 1, p. 185, fig. 100, 1927 (Chesapeake Bay localities).

Diagnosis.—First caudal segment nearly always hexangular, infrequently quadrangular (completely hexangular in 71, incompletely hexangular in one, quadrangular in four specimens); last trunk segment always octangular; penultimate trunk segment nearly always septangular (in 73), infrequently novemangular (in three). In other words, last trunk and first caudal segment only having extra plates in nearly all specimens, infrequently an extra plate missing on first caudual segment or present on penultimate trunk segment; or, upper ridges of tail and trunk nearly always overlapping on two segments, infrequently on one or on three segments. Trunk segments nearly always 11, infrequently 10 (11 complete segments in 73 specimens, the eleventh segment incomplete in one, and 10 segments in only one specimen). Caudal segments usually 36 to 38, varying 35 to 39. Dorsal rays usually 18 or 19, varying 16 to 20. Pectoral rays usually 15 or 16, varying 14 to 17. (The counts differ with the populations; see discussion below.) Spines unusually long in the young, often very conspicuous in medium-sized specimens taken in deep water, relatively well developed in full-grown fish. Coronet well developed. Trunk becoming moderately deep in full-grown specimens; snout of medium length. Filaments usually present, sometimes quite profuse, often absent. Color pattern

typically changes markedly with age; juvenile color pattern consisting chiefly of light-colored blotches around the base of the spines usually more or less coalescent; in large specimens the blotched color partly or wholly replaced by a striped pattern (see below regarding change

FIGURE 60.—*Hippocampus hudsonius hudsonius*, drawn from a specimen 17 mm long from Beaufort, N. C. Length of specimen as drawn, 12 mm excluding spines. The long spines are characteristic of specimens of that size.

and variability of color with size and individual fish); tail typically peppered with small light-colored dots, whitish or bluish in preservative, these dots usually present also on head, back of trunk, and base of dorsal, and much more sparsely on side of trunk; similar dots often

forming radiating rows around eye, sometimes coalescing there to form radiating lines. Dorsal margined with a hyaline band, under-

FIGURE 61.—*Hippocampus hudsonius hudsonius*, drawn from a male 50 mm long from Norflok, Va.; U. S. N. M. no. 91381. Length of specimen as drawn, 34 mm. Color pattern represented nearly typical of specimen of that size. Development of tubercle nearly typical of males of that size.

laid by a dark band broadening anteriorly to form a dark or black diffuse blotch, the dark band and blotch merging gradually with the

dusky shade of the basal part of the fin. According to Bean (1889) the dorsal, in life, is margined with yellow in the female and orange

FIGURE 62.—*Hippocampus hudsonius hudsonius*, drawn from a male 130 mm long from Horn Island, Miss.; Field Mus. Nat. Hist. no. 16191. Length of specimen as drawn, 72 mm. Color pattern nearly typical of specimens of that size but more sharply marked than usual. Tubercles somewhat better developed than in most males of that size.

in the male. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

Variability of color, spines, and appendages with age, sex, habitat, and individual fish.—The development of filamentous processes varies primarily with the individual and to a minor extent possibly with age. Filaments, either simple or branched, are usually present in moderate numbers on the postorbital spines and those of the coronet and the upper ridge of the trunk; at least a few are present. Sometimes they are quite profuse (fig. 64) or altogether absent. When few they sometimes take the form of short chunky appendages. Specimens with a profusion of filaments were relatively more numerous in the smaller size group, while specimens with a total absence of filaments were comparatively more numerous among the larger fish; but this difference is not pronounced. In either small or large specimens filaments were sometimes profuse and sometimes altogether absent. No appreciable difference with sex in the development of filaments was noted. Small specimens often have very many tablike skinny processes, pimplelike excrescences, and short filaments, besides those on the spines, generally distributed on the head, trunk, and to a lesser extent on the tail. With growth the tabs, pimples, and shorter filaments mostly disappear.

The spines in the young (three specimens 17 to 24 mm from North Carolina examined; fig. 60) are strongly and very unequally developed; generally every alternate spine on the trunk and every third or fourth spine on the upper margin of the tail are inordinately long. These greatly elongate spines rapidly decrease in length with growth (in two specimens 32 and 33 mm the spines are considerably shorter but still relatively somewhat longer as compared with larger specimens). The relative decrease in the length of the spines with growth is somewhat unequal in the two sexes. In general, in seahorses taken in comparatively shallow water, the spines are appreciably but not strikingly unequal in males of about 50 mm long (fig. 61) and females of about 60 mm long. In full-grown specimens the spines are generally reduced to form shorter tubercles, which are either subequal or not strikingly unequal and rather short although usually well developed as compared with most other species or subspecies of *Hippocampus*. Even in full-grown specimens the tubercles are relatively somewhat better developed in females than in males, this condition being more or less evident also in the other species (see p. 509). Development of the spines or tubercles varies to a large extent with individual fish at any given size. Consequently, the foregoing remarks apply only in a general way, with frequent exceptions.

Medium-sized specimens frequently occur with unusually well developed tubercles or rather long spines (fig. 64). Such specimens occur all along the coast including the geographic range of both

subspecies, *hudsonius* and *punctulatus*. In the early part of my study such specimens were tentatively identified as *stylifer* because of their rather long spines. In putting my rough data in presentable form, however, I noted that all such specimens, with one exception, lacked any trace of a brood pouch, apparently being females or sexually undeveloped males. None were over 95 mm, and nearly all were taken in comparatively deeper water or as pelagic specimens. So far I have been unable to discover any other characters to correlate with these unusually well developed spines. In the characters chiefly relied on for the separation of the species and subspecies, counts and measurements, these specimens apparently differ in a north and south direction, on a par with the difference between the subspecies *hudsonius* and *punctulatus*. At any given latitude they agree generally in these characters with the respective populations taken in shallow water. The best explanation I have to offer is that they represent the persistence of a juvenile condition with respect to the development of the spines or tubercles. The absence of any trace of a developing brood pouch in nearly all such specimens also suggests the persistence of a juvenile condition in general.

The color varies greatly with individual fish, but a characteristic color pattern may be recognized, wholly or partly, in most fish with color well preserved. The typical color pattern differs also with age. Smaller and medium-sized fish, about 50 to 85 mm long, have a characteristic blotched appearance, with lighter blotches against a darker background (fig. 61). The light blotches are generally formed around the tubercles and are more or less coalescent. The blotches are often mottled with lighter and darker shades, sometimes with strongly contrasting nearly white and black shades. Sometimes they form figures somewhat resembling hourglasses in shape. In larger specimens the typical, juvenile, blotched color pattern is usually replaced, partly or wholly, by a striped pattern (figs. 62, 63). The trunk has narrow dark brown or black transverse lines against a lighter background. Similar lines are often present and arranged lengthwise on opercle and are continued in a longitudinal direction on the anterior part of the trunk, oftener at its lower anterior corner, where they contrast sharply with the transverse lines. Sometimes these typical lines on the trunk and opercle are broken up to form rows of elongate spots. In most of the available full-grown specimens having the color preserved, at least traces of the juvenile blotches may be discerned, but in some the striped pattern entirely replaces the blotched pattern of the young (as in fig. 62). Often large specimens have the blotches very sharply marked, large in extent but few in number. A pair of such large blotches, one above and one below, may be somewhat confluent, forming a figure roughly suggesting an hourglass (fig. 63).

Preserved specimens often do not show the typical color pattern. Some are very dark, the color pattern being then much obscured or nearly obliterated, and some are very light all over, the pattern then being very faint or nearly absent. Often specimens are irregularly mottled without any definite color pattern. However, although not always well marked and varying greatly with the individual, the typical color (consisting of a blotched pattern in the young, partly or wholly replaced by a striped pattern in large specimens) is characteristic of *hudsonius* as well as its subspecies *punctulatus* and probably also *kincaidi*. It was not observed in any of the specimens of the other species studied, except the single specimen tentatively identified as *villosus* (p. 582), which to some extent has the blotched appearance of *hudsonius*, although not so well marked as in typical specimens of the latter species.

Distinctive characters and relationships.—The relation of the common large seahorse of the more northern States to the one from Cuba and Florida apparently has never been definitely established, but it becomes clear by referring to tables 1 and 3. After reviewing current general works on American fishes one gets the idea that two common species of seahorses, *hudsonius* and *punctulatus*, occur on the Atlantic coast of the United States, the former ranging farther north and the latter being more southern in its distribution. According to some authors [46] both of these common species may be found at the same locality. This assumption is certainly an error, as the data presented herewith prove. Table 1 shows that fish from Chesapeake Bay as compared with those from Florida and Cuba average more caudal segments, fewer pectoral rays, and fewer dorsal rays (not a greater number of dorsal rays, as erroneously stated in current descriptions). As the proportional measurements of the different parts of the fish differ with age and sex, no adequate picture of the frequency distribution of these measurements could be shown by the available material, but the ranges and the averages are given in table 3. This shows that when large specimens of the same sex are compared, northern fish, on the average, have a slenderer trunk and a shorter head, shorter subdivisions of the head (snout and postorbital), slightly shorter trunk, and somewhat longer tail; although the differences in proportional measurements nearly disappear in smaller fish. However, while tables 1 and 3 show distinct and statistically measurable differences in the seahorse populations from the extreme geographical ranges, they also show a high degree of intergradation. Furthermore, this intergradation in the structural characters is evidently gradual with geographic distribution or latitude, and fish from North and South Carolina and from Missis-

[46] Smith, The fishes of North Carolina, pp. 172–173, 1907; and Jordan, Evermann, and Clark, Rep. U.S. Comm. Fish. for 1928, p. 244, 1930.

sippi to Texas are intermediate between the extreme northern and the extreme southern fish. In view of the high degree of intergradation in all the characters studied and the evident gradual change in these characters with latitude, there may seem to be good reasons for treating them all under a single heading. Nevertheless, while they do intergrade, the differences between the populations are numerous, and typical large specimens from the extremes of their geographical range may usually be identified without recourse to locality records. Also, among the species of *Hippocampus* there exists a general condition of nearness of approach or even of overlapping. The populations from the extremes of the geographic range should therefore be recognized as subspecies, *punctulatus* and *hudsonius*, the latter for the large seahorses occurring on the coast of the United States north of Florida.

Only one other species of seahorses, *regulus*, occurs within the geographic range of *hudsonius* as limited in the present paper, and it is easy to distinguish the two, *regulus* having much fewer segments and fin rays (see p. 589). *H. hudsonius* is also very near to the European species *guttulatus* and *europaeus*. The differences between them are discussed under the accounts of those species; in actual practice *hudsonius* may be distinguished from the European species by locality.

TABLE 4.—*Averages of the numbers of caudal segments and fin rays of the subspecies* kincaidi, punctulatus, *and* hudsonius *and the populations of* hudsonius, *calculated from the frequency distributions given in table 1*

Subspecies and population	Caudal segments	Dorsal rays	Pectoral rays
kincaidi: Bermuda	34.8	18.3	16.0
punctulatus: Florida and Cuba	35.9	19.3	16.4
hudsonius:			
North and South Carolina	36.5	18.6	15.8
Mississippi to Texas	36.7	18.7	16.1
Virginia to Maine	37.1	18.5	15.3

Populations.—While the material studied is insufficient for a thoroughgoing racial analysis, a comparison of the averages of the caudal segment and fin ray counts is highly suggestive and indicates that the subspecies *hudsonius* is composed of three distinct stocks. This is shown in table 4, which conveniently includes also the two related subspecies, *punctulatus* and *kincaidi*, for comparison. A study of table 4 together with table 3 shows that the population of *hudsonius* from the coast of North and South Carolina differs from that of Chesapeake Bay and northward in averaging fewer caudal segments, more numerous dorsal and pectoral rays, a deeper trunk, and a somewhat longer snout. The Gulf coast population, that from Mississippi to

Texas, has the caudal segments somewhat intermediate between the two foregoing populations but nearer to that from North and South Carolina, while the dorsal and pectoral ray counts diverge from the northern population to an even greater extent than the population from the Carolinas. The Gulf coast population also has a deeper trunk and longer snout than the northern population. In all these differences the two southern populations are intermediate between the northern population of the subspecies *hudsonius* and the subspecies *punctulatus*. It is evident that we are dealing here with a species consisting of at least five distinct populations, three of which may be regarded as populations of one subspecies while the other two diverge sufficiently to constitute distinct subspecies. Attention may here be called to the discussion of the geographic distribution of the species of *Hippocampus* (p. 511).

Geographic distribution.—The foregoing account and a study of tables 1, 3, and 4 show that the change in the structural characters is gradual with respect to latitude. Consequently, it is evident that geographically as well as morphologically an arbitrary line must be drawn between the subspecies *hudsonius* and *punctulatus*. While the most suitable boundary will need to be determined by a study of more fish from intermediate points, it seems not far fetched to assign tentatively those west of Florida as far as the Rio Grande on the Gulf coast, and those north of Florida on the Atlantic coast, to the subspecies *hudsonius* and those from Florida and Cuba to the subspecies *punctulatus*. An inspection of tables 1, 3, and 4 shows that on the whole fish from North and South Carolina and from Mississippi to Texas approach in their structural characters northern seahorses more than those from Florida and Cuba. Consequently, the geographical limits proposed are not altogether arbitrary but are based to a certain extent on morphology. The arbitrary limit suggested would also agree approximately with the general zoogeographical distribution of the boreal and tropic piscine faunas in the western Atlantic.

Material studied.—Off Seguin, Maine; October 1881; schooner *Charles Haskell* (38900). St. Georges Banks; G. Brown Goode (13110). Narragansett Bay, R. I.; August 13, 1880 (25792). Newport Harbor, R. I.; September 1, 1880 (26040). Off Block Island, R. I.; August 3, 1880; schooner *W. M. Goffney* (38950). Patchogue, Long Island, N. Y.; September 14, 1884 (36087). Off Long Island; lat. 40°01′ N., long. 68°54′ W.; surface (31876). Somers Point, N. J.; September 13, 1887; T. H. Bean (45102). Great Egg Harbor Bay, N. J., August 23, 1887; T. H. Bean (45103). Ocean City, N. J.; August 1, 1887; T. H. Bean (45104). Chincoteague, Va.; July 1913; J. B. Henderson (76979). Off Virginia, lat. 37°27′ N., long. 73°33′ W.; surface; October 26, 1886; *Albatross* (38189). Cape Charles City, Va.; October 1, 1897 (67885). Cape

Charles, Va. (91377, W. H. Sterling, July 22, 1897; the following three specimens taken by W. C. Schroeder in 1921: 91376, Sept. 22; 91378, Sept. 23; 91379, Nov. 23; one specimen in Bureau of Fisheries, Oct. 1894, *Fish Hawk*). Cherrystone, Va. (29108, Aug. 1881, M. McDonald; 30399, 1882, *Fish Hawk*). Britton Bay, Md.; September 29, 1911; P. Butter (77909). Potomac River, 4 miles north of Colonial Beach, Va.; summer 1915; J. J. Maxwell (76790). Hooper Island to Cedar Point, Md.; March 31, 1921; *Fish Hawk* (91375). Crisfield, Md.; August 1, 1879; T. B. Ferguson (23533). Yorktown, Va., in York River; October 11, 1921; W. C. Schroeder (91382). Old Point, Va.; Farragut (3451). Off Ocean View, Va.; September 22, 1893; *Fish Hawk*. Norfolk, Va., James Fishery; W. C. Schroeder; 1921 (91380, September 19; 91381, September 30). Off North Carolina, taken by the *Albatross* as follows: Lat. 35°01′ N, long 75°12′ W.; surface, October 17, 1885 (92735); lat. 34°45′20″ N., long. 75°38′10″ W., surface October 18, 1885 (92629); lat. 34°38′ N., long. 76°12′ W., October 19, 1885 (92746); lat. 34°35′30″ N., long. 75°45′30″ W., October 18, 1885 (93679). Beaufort, N. C.; H. C. Yarrow (15015 and 19520). Beaufort, N. C.; June 3–20, 1904; Bean and McKnew (51871 and 51872). Beaufort, N. C., several localities in vicinity; taken by staff of Fisheries Biological Station. Wilmington, N. C.; A. Ruse (92788). South Carolina coast (4316). Charleston, S. C.; steamer *McCulloch* (30728). Horn Island, Miss.; S. Springer (Field Mus. Nat. Hist. nos. 16191 and 16192). Cat Island, Miss.; S. Springer (Field Mus. Nat. Hist. no. 21605). Louisiana; H. Adam. Barataria Bay, La.; 3 specimens taken by author in shrimp trawl; November 24, 28, and 29, 1931. Harbor Island, Tex.; December 1, 1926; J. C. Pearson. Aransas Bay, Tex., near south end; in shrimp trawl; November 2, 1931; K. H. Mosher. Corpus Christi, Tex.; C. T. Reed (93595). Rio Grande, Tex.; March 20, 1883; C. M. Scammon (32558).

Total number of specimens studied, 76; 5 specimens 17 to 33 mm long; 39 specimens 43 to 150 mm long, with a brood pouch or at least a rudiment of one; 32 specimens 42 to 116 mm long, without any trace of a brood pouch.

Synonymy.—The name *H. laevicaudatus* has been placed by previous authors in the synonymy of *hudsonius*, and this action is followed here. There is nothing in the original description to indicate whether it refers to the present subspecies or to *punctulatus*, and the given locality, "North America", does not help to decide the question. In either case it does not affect the nomenclature, since it is a later name than either *hudsonius* or *punctulatus*. The length of the snout shown on the figure of *laevicaudatus* is more nearly like that of *hudsonius*.

HIPPOCAMPUS HUDSONIUS PUNCTULATUS Guichenot

FIGURES 63, 64

Hippocampus erectus PERRY, Arcana; or The museum of natural history, pl., May 1, 1810 ("native of the American Seas, and of the coasts adjacent to Mexico and the West Indies"; agrees most nearly with present subspecies, but may also apply to other seahorses).

Hippocampus punctulatus GUICHENOT, *in* de la Sagra's Historia física, política y natural de la isla de Cuba, vol. 4, Reptiles y peces, p. 239, pl. 5, fig. 2, 1853 (Cuba).

Hippocampus marginalis HECKEL, *in* Kaup's Catalogue of the lophobranchiate fish in the collection of the British Museum, p. 15, 1856 (Mexico).

Hippocampus fascicularis HECKEL, idem (Mexico).

Hippocampus punctulatus DUMÉRIL, Histoire naturelle des poissons. . ., vol. 2, p. 508, 1870 (type of *punctulatus* redescribed).

Hippocampus stylifer JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol 5, p. 265, 1882 (Florida, based on young female).

Hippocampus punctulatus JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 1, p. 777, 1896 (*marginalis* and *fascicularis* placed in synonymy).

Hippocampus punctulatus EVERMANN and KENDALL, Rep. U. S. Comm. Fish. for 1899, p. 63, 1900 (Tarpon Springs, Fla.).

Hippocampus poeyi HOWELL RIVERO, Mem. Soc. Poey Univ. Habana, vol. 8, p. 32, fig., 1934 (off the coast of Habana in algae; probably based on specimen of present species).

Diagnosis.—First caudal segment nearly always hexangular (in 28), infrequently quadrangular (in one); last trunk segment always octangular; penultimate trunk segment usually septangular like the segments in front of it, sometimes novemangular (of 29 specimens examined two completely and one incompletely novemangular.) In other words, extra plates for support of dorsal normally present on first caudal and last trunk segments only, infrequently absent on first caudal and sometimes present on penultimate trunk segment (the single specimen lacking the plate on the first caudal had one on the penultimate trunk segment); or, upper ridges of trunk and tail normally overlapping on two segments, sometimes on three. Trunk segments nearly always 11 (in 28), infrequently 12 (in one, this being the same specimen having a quadrangular first caudal segment). Caudal segments usually 35 to 37, varying 33 to 37. Dorsal rays usually 19 or 20, varying 18 to 21. Pectoral rays usually 16 or 17, varying 15 to 19. Spines long or moderately long in the young fry, very conspicuous in medium-sized specimens, especially in females, usually rather well developed in adults, those on trunk sometimes nearly obsolescent in full-grown males. Coronet well developed, sometimes low in full-grown males. Trunk becoming conspicuously deep in full-grown specimens, snout rather long. Filaments usually present, sometimes profuse, often absent. General color pattern about the same as in *hudsonius;* medium-sized specimens generally with light-colored or variegated blotches around the bases of the

FIGURE 63.—*Hippocampus hudsonius punctulatus*, drawn from a male 107 mm long from Cuba; U.S.N.M. no. 87385. Length of specimen as drawn, 74 mm. Note the obsolescent tubercles. This seems to be characteristic of males of the Cuban population and of that from Bermuda (the subspecies *kincaidi*). In the Florida population the tubercles are usually better developed in males of the same size, and they are best developed in the northern populations (the subspecies *hudsonius*). The spots on the trunk represent an individual variation and the persistence in part of the juvenile color pattern. This variation in the adult color pattern seems to be commoner in the Cuban population but is also often present in the subspecies *hudsonius* and *kincaidi*. The spots are sometimes larger.

FIGURE 64.—*Hippocampus hudsonius punctulatus*, drawn from a specimen, with a rudimentary brood pouch, 91 mm long from Tampa Bay; U.S.N.M. no. 49714. Length of specimen as drawn, 63 mm. Three variations from the usual shown: (1) Spines notably longer for a specimen of its size; (2) filaments profusely developed and branched; (3) persistence in part of the juvenile spotted color pattern, shown also in figure 63, except that in this specimen the spots are not mottled. This specimen happens to show all three variations; usually they are not correlated. All three variations occur also in the subspecies *hudsonius* and *kincaidi*.

spines, against a darker background; full-grown specimens typically with narrow lines partly or wholly replacing the blotches, transverse on trunk, lengthwise on head and anterior part of the trunk, the contrasting directions of the lines usually striking along the boundary where they meet; white lines sometimes alternating with the brown lines on the opercle; bluish or whitish dots quite profuse, except on the side of the trunk, radiating rows of such dots or radiating white lines often present around eye; dorsal with a submarginal dark band. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

The variability and development of the filaments, spines, and the color pattern are quite similar to the subspecies *hudsonius*. In general, the spines are usually somewhat shorter than in *hudsonius* when specimens of approximately the same size and the same sex are compared. As in *hudsonius*, specimens sometimes have the brown lines on the trunk and head broken up into series of spots. These spots sometimes lose their rowed arrangement and such specimens approach individuals of *reidi* in color.

Four specimens were examined from Cuba. Two large males have the spines on trunk and coronet very low, almost obliterated in the largest male, 107 mm long (fig. 63), being nearly like specimens of *reidi* or *hippocampus* in this respect; but the tubercles on the tail are conspicuously better developed than in those two species. A young specimen 23 mm long also has the spines notably short for its size, strikingly shorter than in a specimen of similar size from Key West. The fourth specimen, a female 56 mm long, has the tubercles nearly as well developed as specimens of similar size from Florida. From these four specimens, therefore, it seems that the Cuban population has, on the average, the tubercles not so well developed as the Florida population. However, in the counts and measurements these four agree well with those from Florida, and the difference between the two populations apparently is of no more than racial magnitude.

Distinctive characters and relationships.—The relation of this subspecies to *hudsonius* has already been discussed (p. 557). Typical full-grown specimens have a strikingly different appearance from *hudsonius* on account of their deeper body, longer snout, and somewhat lower tubercles and coronet. It also has a lower average caudal-segment count and higher fin-ray count. The bluish or whitish dots are generally more profuse and more prominent, the brown lines on the head and trunk are oftener better defined, and the opercle sometimes has white lines alternating with the brown; but there is considerable intergradation between the two subspecies, as noted. The differences between this subspecies and *reidi* are discussed under the account of *reidi* (p. 575).

Geographic distribution.—It was suggested (p. 559) that the geographical limits of the State of Florida be arbitrarily considered as the northern geographical limit of *punctulatus*. The specimens examined from Florida represent the range from Biscayne Bay to Pensacola. South of Florida specimens were examined from Cuba. This must stand for the present as the known range of *punctulatus*, and its precise distribution remains to be determined; but in any case its geographical limits on the coast of the United States will have to be arbitrary.

Whether the seahorses from islands adjacent to Florida and Cuba are referable to *punctulatus* or to some other species or subspecies remains to be learned. Records in the literature of "*punctulatus*" from other West Indian islands or the coast of South and Central America appear doubtful or are evidently erroneous. On account of the general failure of authors to discriminate properly between the species of *Hippocampus*, it is not possible to state to which species a given record belongs unless the specimens on which the record is based are reexamined.

Material studied.—Biscayne Bay, Fla; December 5, 1902; H. F. Moore (67596). Key West, Fla. (89786, Pinchot expedition, April 10, 1929, and 38689, *Albatross*, January 14, 1885; also, a very small specimen in Bureau of Fisheries collection, June 10, 1919). Off southern Florida; lat. 26°19′ N., long. 83°33′ W.; March 18, 1889, *Grampus* (43579). Captiva Pass, Fla.; O. P. Hay (Field Mus. Nat. Hist. no. 32829). Tampa Bay, Fla.; *Fish Hawk* (49714; 49715; 49716; 49717). Port Tampa; January 19, 1898; *Fish Hawk* (84598). Tarpon Springs, Fla. (93753, D. Melisas, April 11, 1930; also one specimen in Bureau of Fisheries, Evermann and Kendall, November 7, 1896). Off Cedar Keys, Fla.; lat. 28°56′ N., long. 82°55′ W.; April 3, 1887; J. F. Mosher (39361). Cedar Keys, Fla. (86117, C. R. Aschmeier; 22213; the two larger specimens in the last bottle apparently belong to *hudsonius* and may have been added later, since the register records only one specimen for that number). Pepperfish Key, *Fish Hawk* (73240). Apalachicola Bay, Fla.; shrimp trawl; June 22, 1932; collected by the author. Off Cape San Blas, Fla.; lat. 29°11′30″ N., long. 85°29′ W.; February 7, 1885; *Albatross* (93678). Pensacola, Fla. (30876, Jordan and Stearns, type of *H. stylifer;* 30788, S. Stearns). Cuba, near western end, obtained by Tomas Barrera expedition in 1914, as follows: Cape Cajon, submarine light, May 26 (82386); Punta Colorado, submarine light, May 21 (82385); Ensenada Santa Rosia, 23 mm, dredged in 1–3 fathoms, May 18 (82388); Esperanza (82387).

Total number of specimens studied, 29; 13 specimens with a brood pouch or the rudiments of one, 60 to 162 mm; 13 specimens without a trace of brood pouch, 49 to 142 mm; also three small specimens, 23–32 mm.

Nomenclature and synonymy.—The account of *H. erectus* possibly represents this subspecies, as stated on p. 517. The only relevant matters contained in that account that may be of some aid in determining what species was meant to be represented are: The depth of the trunk and the length of the snout as shown by the figure, and the size and color, which are described as "* * * its size varies from seven inches to nine * * *. The colour of the body is of a pale amber, shaded with brown, and which is divided into ribs transversely placed, and continued in a closer manner upon the neck and tail * * *." Of the known species occurring in the region comprised in the geographical range of *erectus* as given by Perry the description of the size and the "ribbed" color pattern, and the deep trunk and the comparatively rather long snout shown on the plate, agree most nearly with the form later described by Guichenot as *punctulatus*. The next best form to which the account approaches is *hudsonius*, with which it agrees fairly well, and if part of Perry's material comes from the coast of the United States, north of Florida, he probably had a mixture of these forms. However, it is quite possible that Perry's specimens represented still another species or subspecies, such as *kincaidi*. While the name *erectus* is here synonymized with *punctulatus*, I continue to use the latter name, although it was established at a later date, for two reasons: (1) It is a well-established name that has been used for this southern seahorse for three quarters of a century (remarks made on p. 516 in regard to generic name apply also to specific name); and (2) there is no means now of determining with absolute certainty what *erectus* actually represents.

There is no question that Guichenot had material of the present subspecies when he described his fish, and the name *punctulatus* belongs to it rather than to the other common West Indian seahorse, which is here designated as *reidi*. The deep body shown on the plate and the comparatively well developed spines as described and figured indicate without a doubt that the name *punctulatus* belongs to the subspecies described herewith. The spots he describes as "una mancha morena, jaspeada de blanco, de cada lado del lomo y de la base de la cola" are often developed in various positions on the trunk, and are sometimes nearly all white. These characteristic spots are often present also in the subspecies *hudsonius* and *kincaidi*. However, while characteristic of the three subspecies, these spots are more often faint or entirely absent in large specimens.

The discussion following gives the reasons for adopting the synonymy as here given. While the type of *stylifer* only has been examined, the variability of the species as worked out on the available material indicates that this synonymy is most probably correct. It has been partly suggested also by previous investigators.

H. marginalis and *H. fascicularis*, judged by the description of the color, were apparently based on specimens of the present subspecies. The longitudinal lines on the front part of the trunk contrasted with transverse lines posteriorly, as described for *marginalis*, is especially characteristic of *punctulatus*, although specimens often occur in which this color pattern is obscured. Substantially the same color pattern is described for *fascicularis*, but the specimen for which this name was proposed evidently had the alternating white lines on the opercle and the lower anterior corner of the trunk very prominent, which attracted Heckel's attention (see above color notes on *punctulatus* and *hudsonius*).

H. stylifer was based chiefly on the strong development of some of the tubercles, assuming the form of rather long spines. The type of *stylifer* is a small specimen, 55 mm long, without any trace of a brood pouch, taken in deep water, which would account for the relatively long spines, longer than usual in specimens of that size (see p. 556). It has 18 dorsal rays, not 16 as stated in the original description.

H. poeyi, based on a single small[47] female, seemingly a young specimen, is apparently another name to add to the synonyms of *punctulatus*. The counts of the segments and fin rays given in the original description distinctly fall within the range of variation of this subspecies. The figure of the type shows the spines somewhat lower than usual in females of *punctulatus* of about that size; but the development of the spines in *punctulatus* varies greatly with individual fish, some specimens assuming the adult condition when small. If the figure is correctly outlined, it may represent a young *reidi*, but it remains to be seen whether that species occurs on the coast of Cuba, and it is more likely that it is a young *punctulatus*. If *poeyi* is different from either of those two, there is nothing in the original description to show it.

Howell states in regard to his type: "Este ejemplar es cercano al *Hippocampus punctulatus* Guichenot del que difiere por las proporciones generales, la posición de la dorsal y la coloracion." The position of the dorsal as shown on the figure is about that usual in *punctulatus*, and besides there is a certain degree of variation in that respect. The proportional measurements and the color vary much with individual fish and to a still more marked extent with age, the typical condition not being developed except in full-grown or nearly full-grown specimens.

[47] After becoming familiar with the variability and the age, sex, and specific differences shown by the species of *Hippocampus*, I think it is worse than useless to attempt to base a new species of seahorse on a single specimen, especially a juvenile, unless it shows some salient specific character; at least not until after the range of variation of closely related species is determined by a study of series of specimens of like size and in the same sex. This is true to a certain extent in other groups as well, but it is especially true of seahorses. An attempt to describe a new species of seahorse without at least a series of specimens of closely related species for comparison cannot but result, in most cases, in a distinct disservice to the cause of science.

HIPPOCAMPUS HUDSONIUS KINCAIDI Townsend and Barbour

Hippocampus antiquorum GOODE (not Leach), Amer. Journ. Sci., vol. 14, p. 291, 1877 (Bermuda).

Hippocampus kincaidi TOWNSEND and BARBOUR, New York Zool. Soc. Bull. 23, p. 304, fig., 1906 (Bermuda).

Hippocampus brunneus BEAN, Proc. Biol. Soc. Washington, vol. 19, p. 32, 1907 (Bermuda).

Hippocampus punctulatus BEEBE and TEE VAN (not Guichenot), Zoologica, vol. 13, p. 40, 1933 (Bermuda).

Diagnosis.—First caudal segment hexangular (incompletely hexangular in one out of six specimens); last trunk segment octangular; penultimate trunk segment usually septangular (in five), sometimes novemangular (in one). In other words, extra plate for support of dorsal usually on first caudal and last trunk segments only, some times also on penultimate trunk segment; or, upper ridges of trunk and tail usually overlapping on two segments, sometimes on three. Trunk segments 11 (in all six examined). Caudal segments 33 to 36. Dorsal rays 18 or 19. Pectoral rays usually 16, varying 15 to 17. Tubercles and coronet well developed in young specimens, becoming notably low in large fish, frequently obsolescent on upper ridge of trunk in large males. Trunk of medium depth; snout of medium length. Filaments rather profuse in young, absent in the few large specimens examined. Color not well shown in the few available specimens; large whitish or variegated blotches shown on trunk of two specimens, largest specimen shows traces of transverse dark lines on trunk; white dots usually quite profuse on tail, sparse on side of trunk; general color pattern apparently the same as in *hudsonius* and *punctulatus*. (See tables 1 and 3 for counts and measurements and table 4 for averages.)

The figure of *kincaidi* and the color description of "*brunneus*", combined with the specimens examined, make it evident that the variability of the tubercles, filaments, and color with age is approximately the same as already described for *hudsonius* or *punctulatus* (see pp. 555 and 564).

Distinctive characters and relationships.—The Bermuda population of this seahorse evidently forms a subspecies of equal rank with *hudsonius* and *punctulatus*. The relation between these latter two has been discussed under their accounts, and *kincaidi* may now be compared with them. The differences between the three subspecies become apparent by a study of tables 1, 3, and 4. *H. kincaidi* is characterized by a combination of characters: A low caudal segment count; the low tubercles in large males tending to become obsolescent; a trunk of medium depth; a snout of medium length; a rather low dorsal ray count; a medium pectoral ray count. In its low caudal segment count and low tubercles it is nearest to *punctulatus*, especially

to the Cuban population of that subspecies; in the depth of its trunk, the length of the snout, and the pectoral ray count it is nearest to the southern populations of *hudsonius*, while in the dorsal count it is nearest to the northern population of that subspecies. Although the number of specimens from Bermuda studied are few and the precise range of variation of this population remains to be worked out, it seems apparent that if *hudsonius* and *punctulatus* are to be recognized as subspecies, *kincaidi* also should be recognized as having equal rank with them.

In its comparatively lower tubercles, fewer caudal segments, and slenderer body *kincaidi* approaches *reidi*, and the differences between them are discussed under the latter (p. 575).

Material studied and geographic distribution.—Bermuda (23795, F. M. Hamlin, 1879; 23805, G. Brown Goode, 1877; also Field Mus. Nat. Hist. nos. 5064, 5065, 5066, and 5495, T. H. Bean).

Total number of specimens examined, 6; 4, with a brood pouch, 75 to 118 mm long; 2, without any trace of a brood pouch, 61 and 62 mm. Apparently *kincaidi* is now known only from the coast of Bermuda.

Nomenclature and synonymy.—Although the types of *kincaidi* and *brunneus* were not examined, they unquestionably pertain to the subspecies here described. Apparently the former was based chiefly on the strongly developed tubercles and their long, branched filaments, while *brunneus* was based chiefly on color, the presence of large blotches in the form of hourglasses. The present study definitely determined that in *hudsonius*, as well as in *punctulatus*, the high tubercles, the profuse filaments, and the blotches are normally juvenile characters that often persist in medium-sized or even nearly full-grown specimens (see pp. 511 and 555). Evidently the same variation occurs in *kincaidi*, although I do not have sufficient specimens to determine this definitely. The tubercles and filaments of *kincaidi* indicated on the published figure and the color of *brunneus* as described show that neither was based on specimens of *reidi*, the other large seahorse occurring at Bermuda.

Both *kincaidi* and *brunneus* were established on misapprehensions, since the characters that apparently induced their describers to establish the names are well shown by the subspecies *hudsonius* and *punctulatus* during certain stages of growth or as an individual variation. However, since the Bermuda population is subspecifically distinct from *hudsonius* and *punctulatus* on the basis of other differences, the names *kincaidi* and *brunneus*, the former having priority, are available for that population.

HIPPOCAMPUS HIPPOCAMPUS (Linnaeus)

Syngnathus hippocampus LINNAEUS, Systema naturae, ed. 10, p. 338, 1758 (as restricted by Leach, 1814; originally a composite species).

Hippocampus heptagonus RAFINESQUE, Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, p. 18, 1810 (substitute for *S. hippocampus* Linnaeus to avoid tautonymy).

Hippocampus antiquorum LEACH, The zoological miscellany vol. 1, p. 104, 1814 (Mediterranean only locality mentioned; substitute for *S. hippocampus* Linnaeus to avoid tautonymy; seahorses split up into more than one species and this name restricted to a Mediterranean species).

Hippocampus brevirostris SCHINZ, Das Thierreich von Cuvier, vol. 2, p. 262, 1822 (substitute for *S. hippocampus* Linnaeus to avoid tautonymy, the latter name being previously restricted by Leach to the Mediterranean species having blunt tubercles).

Hippocampus antiquus RISSO, Histoire naturelle des principales productions de l'Europe méridionale . . . , vol. 3, p. 183, 1826 (description most likely refers to present species, see p. 521).

Hippocampus brevirostris CUVIER, Le règne animal, ed. 2, vol. 2, p. 363, 1829 (name anticipated by Schinz, 1822).

Hippocampus brevirostris GUÉRIN-MÉNEVILLE, Iconographie du règne animal du G. Cuvier, vol. 2, Poiss., pl. 65, fig. 2, 1829–38.

Hippocampus jubatus DE LA PYLAIE, Congr. Sci. France, Poitiers, 1834, 2d sess., p. 528, 1835 (either a pre-Linnaean name or else a nomen nudum, see p. 524).

Hippocampus brevirostris RAUTHER, Die Syngnathiden des Golfes von Neapel, p. 8, pl. 2, figs. 11, 16, and 18, pl. 16, fig. 173, 1925 (gives also extensive account of biology and anatomy of species).

Diagnosis.—First caudal segment usually hexangular, often quadrangular (completely hexangular in seven, incompletely hexangular in one, quadrangular in three); last trunk segment octangular; penultimate trunk segments usually septangular like segments preceding it (in eight), often novemangular (in the three specimens having a completely quadrangular first caudal segment noted above). In other words, first caudal and last trunk segment usually with an extra plate on top; when extra plate is absent on first caudal segment it is present on penultimate trunk segments; or, upper ridges of tail and trunk overlapping on two segments, usually on the first caudal and last trunk segment, sometimes on last two trunk segments. Trunk segments 11 (in all 11 specimens examined). Caudal segments modally 35, varying 34 to 36. Dorsal rays usually 17, sometimes 16. Pectoral rays modally 14, varying 13 to 15. Tubercles low in medium-sized fish, becoming nearly obsolescent in large specimens, or at least very low and narrowly rounded above, not pointed, not abruptly stubby. Coronet rather high and blunt, bony tubercles in front of it obsolescent. Trunk deep; snout short. Filaments few, rather short, or entirely absent (highly variable as in related species shown on one of Rauther's figures, plate 16, to have many rather long and branched filaments). Color dark, numerous small brown spots of deeper intensity than ground color more or less evident, sometimes coalescing to form short lines or elongate spots on lower side

of head, often very dark all over and definite spots hardly evident; minute white dots present or absent, often coalescing to form irregular lines or a fine network, especially marked on head and to a lesser extent on trunk, often fine white lines radiating from eye. Dorsal with a whitish marginal band, underlaid by a dark brown submarginal band, basal part more or less dusky, sometimes nearly uniformly dark below marginal whitish band. (See tables 1 and 2 for counts and measurements.)

Distinctive characters and relationships.—*H. hippocampus* is apparently related both to *europaeus* and to *reidi*, as discussed under the accounts of those species. It has a distinctive appearance, owing to its very low or obsolescent tubercles, short snout, and rather deep body. In the low or nearly obsolescent tubercles it somewhat resembles *reidi* but differs markedly in its conspicuously deeper trunk and shorter snout and in having fewer pectoral rays, although there is a small degree of intergradation in the latter character. It may be sharply distinguished from *guttulatus*, its congener occurring in the same region with it, by a number of characters, as pointed out on page 544.

A fair percentage of the specimens tend to have the first caudal segment quadrangular. This deviation occurs less frequently in *hudsonius* and *punctulatus*, while in the subgenus *Jamsus* (see p. 584) it becomes the dominant condition. In *hippocampus* this variation is apparently correlated with a novemangular antepenultimate trunk segment.

Material examined and geographic distribution.—Bay of Naples, S. E. Meek, April 1897, four specimens (48325). Also seven specimens from the collection of the American Museum of Natural History, as follows: Two from the Zoological Station, Naples, Dr. Hovey (1082), and five purchased from the Zoological Station, Naples (5042) without further data. All these no doubt belong to the same species.

Total number of specimens studied, 11, 55 to 104 mm long (one specimen with the tip of the tail broken possibly somewhat larger than the longest specimen recorded here). All the specimens, except the smallest one, have a brood pouch or at least a rudiment of one. According to Rauther most of the females of this species have a brood pouch more or less developed; apparently the sexes cannot be distinguished by that character.

Nomenclature and synonymy.—This species has been designated most generally by the name of *brevirostris*, but the review of the literature (pp. 520 to 522) shows that that name has been proposed as a substitute for the earlier name *hippocampus*, of which it consequently becomes a synonym. In this case there is greater advantage in following the rules rather than general usage and sinking the name

brevirostris to synonymy, since that name was employed often to designate other species as well, such as *europaeus* and species in other parts of the globe. Furthermore, there is no possibility that the name *hippocampus* will have to be changed again. Therefore, it is a fortunate coincidence that sinking the name *brevirostris* as a synonym of *hippocampus* will serve the triple purpose of complying with the code, clearing away the existing confusion implied in the name *brevirostris*, and fixing the name of this species with finality.

Uncertain specimen.—A single specimen in the University of Michigan Museum (111750), found in the same lot of seahorses forming the basis of *multiannularis* (see p. 542), probably belongs to *hippocampus*. Trunk segments 11; caudal segments 37; dorsal rays 18; pectoral rays 15; first caudal segment hexangular; penultimate trunk segment septangular, tubercles nearly obsolescent. Length 102 mm, with a brood pouch; depth 18, snout 6.7, postorbital 10.5, head 20.5, trunk 30.5, tail 67.5, and orbit 4 percent of length. If these measurements are compared with table 2, it will be noted that by the length of its snout this specimen is either a *europaeus* or a *hippocampus*, but its general physiognomy is more like *hippocampus* and agrees more with the latter species in the depth of the trunk and the appearance of the tubercles. The number of caudal segments and dorsal rays falls just outside the frequency distribution of *hippocampus* as determined (compare with table 1); but it seems to fit well in that distribution as an extreme variant. If this specimen was one of the original lot from Dagry Frères (see p. 542) and came from the Bay of Biscay, it seems possible that *hippocampus*, like *guttulatus*, is represented on the Atlantic coast of Europe by a distinct subspecies. However, that remains to be determined. It is more likely that it came from the Mediterranean and represents a variant of its species with respect to the number of caudal segments and dorsal rays.

HIPPOCAMPUS REIDI Ginsburg

FIGURES 65, 66

Hippocampus longirostris KAUP (not Schinz, 1822, a French species; not Cuvier, 1829, see pp. 520 to 523 for discussion), Catalogue of the lophobranchiate fish in the collection of the British Musuem, p. 12, pl. 3, figs. 2, 2a, 1856 (Martinique and St. Lucia; recognizable figure of this species published).

Hippocampus guttulatus GOODE (not Cuvier), Amer. Journ. Sci., vol. 14, p. 291, 1877 (Bermuda).

Hippocampus punctulatus MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 255, 1923 (specimens from Porto Bello only belong to present species).

Hippocampus reidi GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 561, 1933 (Grenada, British West Indies; Porto Bello, Panama; Jamaica, W. I.; Haiti).

Diagnosis.—First caudal segment hexangular (incompletely hexangular in one out of 12 specimens examined); last trunk segment

always octangular; penultimate trunk segment usually septangular, sometimes novemangular (completely novemangular in two specimens and incompletely so in one out of 12 examined). In other words, usually first caudal and last trunk segments only with an extra plate for the support of the dorsal, infrequently missing on first caudal segment and sometimes present on penultimate trunk segment; or, upper ridges of tail and trunk usually overlapping on two segments, sometimes on three. Trunk segments normally 11 (in 11), sometimes 12 (an incomplete twelfth segment in one). Caudal segments usually 35 or 36, varying 34 to 37. Dorsal rays modally 17, varying 15 to 18. Pectoral rays usually 15 or 16, varying 15 to 17. Tubercles on upper ridge of trunk evident in small specimens (one male 46 mm long and two females 50 and 58 mm examined), but quite low, comparatively much lower than usual in specimens of *hudsonius* or *punctulatus* of similar size; in large or medium-sized specimens obsolescent or nearly obsolescent, being sometimes indicated as a slight, broadly wavelike rise (next sizes examined after the small specimens are a male 74 and a female 93 mm). Coronet medium in small and medium-sized specimens, very low in large ones. Trunks unusually slender; snout conspicuously long. Filaments absent on tubercles and coronet of large and medium-sized specimens; present

FIGURE 65.—*Hippocampus reidi*, drawn from the type, a male 121 mm long from Grenada, British West Indies; U.S.N.M. no. 86590. Length of specimen as drawn, about 91 mm.

in small fish of about 50 mm long but few and short; very small tablike processes or minute pimples rather profuse and usually persistent in largest specimens, sometimes short filaments present on back (not on tubercles) of large specimens. Color pattern characteristic; covered more or less thickly with small brown spots against a lighter background, the spots often differing in size, somewhat larger and more prominent spots interspersed with smaller ones, ground color sprinkled profusely with minute, almost microscopic whitish dots (color evident only in the larger specimens, the available smaller ones nearly uniformly colored without any definite color pattern, possibly faded). Dorsal hyaline with a submarginal brown streak and sprinkled at the base with small brown dots. (See tables 1 and 3 for counts and measurements.)

FIGURE 66.—*Hippocampus reidi*, drawn from a female 127 mm long taken with the type. Length of specimen as drawn, 89 mm.

Distinctive characters and relationships.—*H. reidi* agrees most nearly with *hippocampus* from the Mediterranean in its obsolescent tubercles and number of caudal segments and dorsal rays, as well as in its color pattern, but differs sharply in having a conspicuously slenderer trunk and longer snout, while the frequency distribution of the pectoral rays is quite different, although the two species overlap in that respect.

The similarity in the structure of the tubercles, the number of caudal segments and dorsal rays, and the color pattern of *reidi* and

hippocampus may be a case of parallelism, and it is possible that *reidi* is more nearly related to *kincaidi* and *punctulatus*. In any case, whatever is the true relationship of *reidi*, for the practical purpose of identification it is necessary to compare it with them, since its geographic range overlaps with that of *kincaidi* and possibly also with that of *punctulatus*.

Full-grown or nearly full-grown specimens of *reidi* may be sharply distinguished from *punctulatus* by their markedly slender trunk (see table 3) along with the difference in the color pattern, *reidi* being profusely spotted with small spots, while large specimens of *punctulatus* are marked generally by narrow lines or sometimes by large blotches. *H. reidi* also has the tubercles obsolescent, while in *punctulatus* they are in most specimens fairly well developed, although full-grown males sometimes closely approach *reidi* in that respect. Small specimens are not readily distinguished by depth, but may be separated on direct comparison by the difference in the structure of the tubercles, in most, but not all cases, some small specimens of *punctulatus* having the tubercles rather low. As further aids in separating the two, *reidi* has a distinctly lower dorsal fin ray count and a longer snout than *punctulatus*, but there is more or less intergradation in those two characters (see tables 1 and 3).

The present species differs from *kincaidi* in the same characters, namely, in having a slenderer trunk, obsolescent tubercles, fewer dorsal rays, a longer snout, and a different color pattern. It has been noted that *kincaidi* has a slenderer trunk and generally lower tubercles than *punctulatus*, and it consequently approaches nearer to *reidi* in those two important characters. However, to offset this convergence, *kincaidi* has a somewhat shorter snout than *punctulatus*, and it consequently diverges more from *reidi* in this character. While *kincaidi* converges toward *reidi* in the depth of the trunk, there was no intergradation in the few specimens measured (see table 3).

When all the characters are taken into consideration there should be found no difficulty in most cases in distinguishing *reidi* from *kincaidi*, as well as from *punctulatus*. At least, I did not find it difficult. It is reasonable to expect some difficulty, however, in referring occasional extreme variants of *kincaidi* and *reidi* in places where both occur, as in Bermuda. Out of seven specimens of seahorses from Bermuda available, only one may be referred to *reidi* and six to *kincaidi*, and the latter is probably the commoner seahorse on the coast of Bermuda. The single specimen of *reidi* from that coast is fortunately a nearly full-grown individual having the important characters typical of its species, and there is no question as to where it belongs.

Material studied and geographic distribution.—Porto Bello, Panama; Meek and Hildebrand (79685, March 19, 1912; Field Mus. Nat. Hist.

no. 8284). St. George, Grenada, British West Indies; W. O'Brien Donovan (86590, two specimens including the type). Port-au-Prince, Haiti; C. Bencomo (85958; three large specimens, dried and hence could not be accurately measured, nor the fin rays counted, but the count of the segments included in the above account; form, tubercles, and color typical of the species). Jamaica, West Indies; *Albatross;* March 1–11, 1884 (92684). Kingston, Jamaica; *Albatross,* 1884 (93732). Bermuda; G. Brown Goode; 1876–77; 1 female, 137 mm long (21933).

Total number of specimens examined, 12; 6 with a brood pouch or at least a rudiment of one, 46 to about 150 mm long (the largest male dried, and exact length cannot be determined); 6 specimens 50 to 137 mm long, without any trace of a brood pouch.

From the material examined it is evident that this species is common in the West Indies and ranges from Panama to Bermuda, but its precise geographical limits remain to be determined. Among all the available specimens from Florida and Cuba not a single *reidi* was found. Extant records in the literature, of seahorses from the West Indies, no doubt refer partly or wholly to this species, but on account of the failure of previous authors except Kaup to distinguish *reidi* it is not possible to place such records properly in the synonymy unless the specimens are reexamined. The figure published by Kaup shows the slender body, the low tubercles and coronet, and the characteristic color pattern and is readily identifiable as drawn from a specimen of *reidi.* In view of Kaup's evident failure to distinguish the species of *Hippocampus* in many cases, it is doubtful whether all his material was referable to the present species; but one of his specimens from St. Lucia and one from Martinique for which he describes the color apparently belonged to *reidi.* These two localities fall within the geographic range represented by specimens examined during my study.

HIPPOCAMPUS OBTUSUS Ginsburg

FIGURE 67

Hippocampus obtusus GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 562, 1933 (off Cape Hatteras, N. C.)

Diagnosis.—First caudal segment hexangular, last trunk segment octangular, penultimate trunk segment septangular. In other words, first caudal and last trunk segments only bearing an extra plate for the support of the dorsal; or, upper ridges of trunk and tail overlapping on two segments. Trunk segments 11; caudal segments 35; dorsal rays 17; pectoral rays 16. Every third or fourth tubercle on trunk and anterior part of tail very stout and bluntly obtuse, reduced to stout, knoblike stumps, their appearance very characteristic;

FIGURE 67.—*Hippocampus obtusus*, drawn from the type, a male 70 mm long from off the coast of North Carolina; U.S.N.M. no. 84527. Length of specimen as drawn, 55 mm.

tubercles on head, at base of pectoral, and on nape similarly stumpy. Coronet of medium height. Trunk conspicuously slender; snout rather long. First two enlarged spines on tail having short somewhat chunky stumpy appendages, no other filaments, profusely covered with pimplelike excrescences on skin; smaller on side, larger on back. Color nearly uniformly yellowish (probably faded).

Measurements.—Length 70 mm, with the brood pouch just beginning to develop. Depth 12, snout 10.5, postorbital 11, head 24.5, trunk 35, tail 61, and orbit 4.5 percent of length.

Distinctive characters and relationships.—When I first found the specimen forming the type of the present species, I immediately recognized its striking appearance and set it aside as being distinct from *hudsonius*, but I hesitated to describe it as a new species on the bare chance of its being an abnormal specimen of that species, since it was taken within the geographic range of that species and the counts of its meristic characters also fall within the range of variation of the subspecies *hudsonius*. Any doubts as to its distinctive nature were dispelled, however, after I found the three specimens from the Pacific coast that form the basis of *hildebrandi*. As later noted (p. 582), there is no question that *hildebrandi* is a distinct species. The most distinctive and striking character of *hildebrandi*—the structure of the tubercles—is nearly duplicated in the type of *obtusus*, which is evidently the Atlantic coast counterpart of *hildebrandi*, *obtusus* differing chiefly in its fewer caudal segments and dorsal rays.

H. obtusus differs from the other species occurring within its geographic range, *hudsonius*, as well as from all other American species except *hildebrandi*, chiefly in the structure of the tubercles, which is very striking. It is one of those characters hard to describe but may be appreciated fully by direct comparison of material. The tubercles in *obtusus* are very stout and blunt, but they are also low, being reduced to mere stout blunt stumps or knobs. They are unlike the rather slender and notably higher tubercles of *hudsonius*, or the more or less obsolescent tubercles of *hippocampus* and *reidi*. *H. obtusus* differs further from *hudsonius* in having a notably slenderer trunk and a longer snout, more so than even the extreme variants of *hudsonius* of similar size (compare with table 3). The paucity of specimens of *obtusus* in collections, only the type being known, may possibly be explained by its probable offshore habitat, as discussed in the next paragraph.

Material studied and distribution.—Off Cape Hatteras, N. C.; *Albatross;* June 5, 1885 (84527, the type); the only known specimen. This species possibly has more of an offshore habitat, while *hudsonius* is common in shallow water inshore and is also taken offshore. There are no available data as to the habitat of the type, but on the day on which it was captured the *Albatross* was engaged in line fishing

offshore in 50½ to 123 fathoms.[48] While this fact is suggestive, it is not conclusive. It may have been taken at the surface either offshore or inshore. The vertical as well as the geographical distribution of this species remains to be determined.

HIPPOCAMPUS HILDEBRANDI Ginsburg

FIGURES 68, 69

Hippocampus ingens MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 256, 1923 (three specimens from Chame Point, Pacific coast of Panama, referred to the present species).

Hippocampus hildebrandi GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 562, 1933 (Chame Point, Panama, based on specimen of preceding record).

Diagnosis.—First caudal segment hexangular; last trunk segment octangular; penultimate trunk segment septangular, sometimes novemangular (in one specimen out of three penultimate trunk segment incompletely novemangular). In other words, extra plate for support of the dorsal usually present on first caudal and last trunk segment only, sometimes also on penultimate trunk segments; or, upper ridges of tail and trunk usually overlapping only on two segments. Trunk segments 11, caudal segments 39 (same count in all three specimens examined). Dorsal rays 20 (in two) or 21 (in one). Pectoral rays 16 (in one) or 17 (in two). Tubercles on upper ridge not at all pointed, every third or fourth strikingly stout but low, forming characteristic stout, blunt, knoblike stumps (very similar in appearance to those of *obtusus*). Coronet well developed, of medium height. Trunk slender; snout rather long. No slender filaments, but fleshy, short appendages present on some tubercles; profusely covered with pimplelike projections. The three available specimens nearly uniformly dark, without any well-marked color pattern; sometimes with small brown spots irregularly scattered on opercle, trunk and tail. Rays of dorsal dark brown at bases gradually becoming lighter distally; a narrow, longitudinal hyaline streak, a little below middle, interrupting the conspicuous brown color on the rays; interradial membrane hyaline.

Measurements.—Two, without a brood pouch, 46 and 68 mm long; depth 12 and 13.5, snout 10 (in both), postorbital 11.5 and 10.5, head 25 and 24.5, trunk 31.5 and 30, tail 63.5 and 65.5 and orbit 6 and 4.5 percent of length, respectively; one with a rudimentary brood pouch 49 mm, depth 9, snout 10, postorbital 11, head 25.5, trunk 32, tail 61.5, and orbit 6 percent of length.

Distinctive characters and relationships.—The three specimens forming the basis of the foregoing account unquestionably represent a distinct species. There is only one other species, *ingens*, now known from the Pacific coast of Panama, and *hildebrandi* should be compared

[48] Rep. U. S. Comm. Fish. for 1885, p. 80, 1887.

with that. The two have approximately the same number of segments and fin rays (compare with table 1). Hence, it may be suggested that *hildebrandi* represents the young of *ingens*, but it is evident

FIGURE 68.—*Hippocampus hildebrandi*, drawn from the type, a female 68 mm long from the Pacific coast of Panama; U.S.N.M. no. 82036. Length of specimen as drawn, 39 mm.

that such is not the case, although I did not have specimens of the same size in both species for comparison. In the species of *Hippocampus* examined by me, the tubercles are notably better developed

and pointed in smaller fish. This is the invariable rule in all the species examined (except possibly *obtusus* and *hildebrandi* for which no

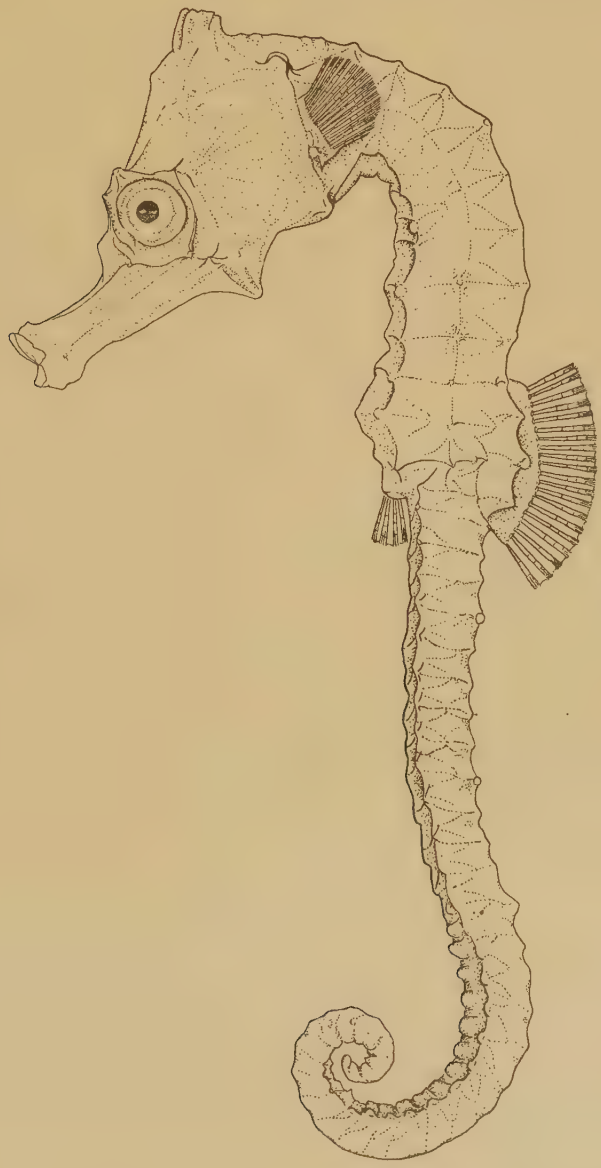

FIGURE 69.—*Hippocampus hildebrandi*, drawn from a male 49 mm long; U.S.N.M. no. 82039. Length of specimen as drawn, 35 mm. Note the very rudimentary tubercles in a male of this size, although in other species the tubercles are well developed in such small specimens. A smaller female, 46 mm long, U.S.N.M. no. 82037, has the tubercles better developed but stumpy, essentially as in figure 68.

series of specimens in graduated sizes are available), and is also true of *ingens*. The smallest available specimen of *ingens* is 113 mm long and the largest 201 mm. The tubercles in *ingens* are notably better devel-

oped in the smaller specimens, being distinctly higher and spinous, as in the other species of *Hippocampus*, while in the three specimens here assigned to *hildebrandi* the tubercles are much broader and lower, although these three are considerably smaller than the smallest specimen of *ingens* examined. The difference in appearance is very striking, but it is hard to convey an adequate verbal picture, and this difference may be appreciated fully only by a direct comparison of material. After familiarity is gained with the change in the appearance of the tubercles on account of growth in the species of *Hippocampus*, a comparison between the available specimens of *ingens* and *hildebrandi* will force the conclusion that they represent distinct species. *H. hildebrandi* is evidently most nearly related to *obtusus* from the Atlantic coast, differing sharply in having more caudal segments and dorsal rays.

Material examined and distribution.—Chame Point, Pacific coast of Panama; Robert Tweedlie (82037; 82039; 82063, the type); two specimens, 46 and 68 mm long without any trace of a brood pouch, 1 specimen 49 mm long with a rudimentary brood pouch.

All three specimens were captured by Robert Tweedlie, whose methods of collecting are described by Meek and Hildebrand,[49] as follows: "* * * most of his specimens were either dipped up by the sand dredge * * * or taken with the dip-net * * * in the vicinity of the dredge. * * * the position of the dredge * * * was located at the end of Chame Point, a long and very narrow neck of land projecting a distance of about thirty miles into the sea." Therefore, it is possible that this species has an offshore habitat as was discussed for its close relative *obtusus* (p. 578). A fourth specimen obtained by Tweedlie is a true *ingens* and was included in the account of that species. The two Pacific coast species, therefore, apparently overlap in their ranges, even though they may be found to differ in their vertical distribution.

HIPPOCAMPUS VILLOSUS Günther

Hippocampus villosus GÜNTHER, Zoology of the voyage of H.M.S. *Challenger*, vol. 1, pt. 6, Fishes, p. 8, pl. 1, fig. D, 1880 (off Bahia).

Hippocampus punctulatus MEEK and HILDEBRAND (in part), Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 255, 1923 (the specimen from Fox Bay, Colon, Panama, here referred provisionally to *villosus*.)

Diagnosis.—First caudal segment hexangular, last trunk segment octangular, penultimate trunk segment septangular like the segments preceding it. In other words, an extra plate for the support of the dorsal on last caudal and first trunk segments only; or, upper ridges of tail and trunk overlapping on two segments. Trunk segments 10; caudal segments 34; dorsal rays 16; pectoral rays 15. Tubercles on upper ridge of trunk well developed and pointed. Coronet high.

[49] Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 1, p. 6, 1923.

Trunk deep; snout of medium length. Filaments short, more or less branched, present on spines of head and of upper ridge of trunk and anterior part of tail. Brown, with lighter blotches around bases of spines of trunk, the blotches coalescent (the color pattern somewhat as in specimens of *hudsonius* or *punctulatus* of similar size); white dots present, but scanty; dorsal with obliquely longitudinal rows of rather faint brownish spots near base, no submarginal band.

Measurements.—Length 68 mm, without any trace of a brood pouch; depth 17, snout 8.5, postorbital 12, head 24, trunk 38, tail 56.5, and orbit 4.5 percent of length.

Distinctive characters and relationships.—The foregoing account is based on a single specimen that I refer with considerable doubt to Günther's species, which is also known from but one specimen. The species of *Hippocampus* are so variable intraspecifically, and so closely approaching or even overlapping interspecifically, that it seems foolhardy to base a species on a single specimen, except where it shows some salient character unmistakably distinguishing it. There must be even greater uncertainty to attempt to identify a single specimen with a poorly established species without comparing it directly with the type. However, this specimen is evidently of a different species from any of the others from the American coasts described in the present paper, and it agrees fairly well with the inadequate account of *villosus*, except that Günther's specimen apparently had a longer snout. Not wishing to establish a new species on a single specimen in this case, I provisionally refer it to *villosus*.

Judged from the species from the American coasts known at present, this specimen belongs to a species nearest to *reidi* on one hand and to *punctulatus* on the other, but it apparently differs from both. The most striking feature is its relatively small number of segments, both trunk and caudal segments. The 10 trunk segments represent the most usual number found in the subgenus *Jamsus*. Of the other species described herein, only one specimen of *hudsonius*, out of 76 examined, had this number, while in all the rest of the species not one specimen was found with 10 trunk segments. It is possible that the specimen here referred to *villosus* represents a rare variant, but the probabilities are much more strongly in favor of its representing a species that normally has fewer trunk segments. The number of caudal segments is also near to the normal condition in the subgenus *Jamsus*, but it also falls at the extreme of the frequency distributions of *reidi* and *punctulatus* (compare with table 1). This specimen further differs from *reidi* in its deeper body and strikingly better developed tubercles, and from *punctulatus* in having a deeper body when specimens of approximately the same size are compared (see table 3). From the two species belonging to the subgenus *Jamsus* it differs

strikingly in its larger size and also in having more numerous dorsal and pectoral rays.

Material studied.—Fox Bay, Colon, Panama; Meek and Hildebrand; March 25, 1911 (81727); one specimen without any brood pouch.

JAMSUS, new subgenus

Genotype.—*Hippocampus regulus* Ginsburg.

Definition.—Dorsal rays 10 to 14. Pectoral rays 10 to 12. Trunk segments usually 10, often 9, infrequently 11. Caudal segments 28 to 34. Upper ridges of tail and trunk usually overlapping on one segment, sometimes on two, rarely on none; usually on last trunk segment, often on first caudal. First caudal segment usually quadrangular; last trunk segment usually octangular (last trunk and first caudal segments often both hexangular in *zosterae*, in those specimens having nine trunk segments, see p. 590). Penultimate trunk segment, like the segments in front of it, usually septangular, infrequently novemangular. Base of dorsal on two segments, usually on last two trunk segments, often on last trunk and first caudal segments. Size notably small.

Relationships.—*Jamsus* is evidently related to the typical subgenus but differs from it chiefly in having fewer fin rays, fewer trunk and caudal segments, and normally one instead of two extra plates for the support of the dorsal. In the number of dorsal and pectoral rays there are no intergradients between the two subgenera in the species studied. *Jamsus* contains two species, which are notably small in size, and their smaller size is correlated with a lesser number of fin rays and segments.

Etymology.—An arbitrary combination of two Biblical Hebrew words: jam [50]=sea, and sus [50]=horse, nouns in masculine gender according to the rules of Hebrew grammar; transliterated into the Latin alphabet according to the rules of the Library of Congress,[51] except that the Hebrew letter "yod" is rendered into "j", equivalent to the old Latin consonantal "i"; the "j" pronounced like the English "y.",

HIPPOCAMPUS REGULUS Ginsburg

FIGURES 70, 71

Hippocampus regulus GINSBURG, Journ. Washington Acad. Sci., vol. 23, p. 563 1933 (Mississippi; Texas; Campeche, Mexico).

Diagnosis.—First caudal segment nearly always quadrangular (incompletely hexangular in one out of 24 specimens examined), last trunk segment always octangular, penultimate trunk segment nearly

[50] See, for instance, Exodus 15:1.

[51] See also Funk & Wagnalls Jewish Encyclopaedia, vol. 2, p. IX.

always septangular (incompletely novemangular in one out of 24 specimens). In other words, an extra plate for support of the dorsal normally on last trunk segment only, infrequently also on first caudal or penultimate trunk segment (on one side only of each one of two specimens out of 24 examined); or, upper ridges of tail and trunk normally overlapping on one segment only (with the exception noted). Trunk segment 10 (in 23), sometimes 9 (in one specimen from Campeche). Caudal segments usually 29 to 31, varying 28 to 32. Dorsal rays modally 11, varying 10 to 12. Pectoral rays modally 11, varying 10 to 12. Base of dorsal on last two trunk segments. Tubercles on upper ridge fairly well developed and pointed, sometimes low in full-grown males. Coronet comparatively high. Filaments usually present, relatively not long, their numbers varying greatly with individual fish and to some extent with age, sometimes profuse and more or less branched, often absent or nearly absent, especially in full-grown specimens; minute pimples usually profuse. Color variously mottled with yellowish of contrasting intensity or with brownish, without any definite color pattern; basal two-thirds of dorsal with lengthwise rows of small diffuse spots, often more or less coalescent, forming a diffuse network, sometimes nearly uniformly pigmented but increasingly darker proximad; sometimes with a distinct submarginal dark band, sometimes nearly hyaline. (See table 5 for counts.)

Measurements.—A male, 30.5 mm long, depth 18.5, snout 7, postorbital 12, head 22.5, trunk 34, tail 62.5, and orbit 6 percent of length. A female, 26.5 mm long, depth 17, snout 8.5, postorbital 13, head 25.5, trunk 36.5, tail 55.5, and orbit 7.5 percent of length.

Distinctive characters and relationships.—This species is evidently closely related to *zosterae*. The greatest divergence is in the number of dorsal rays, although there is a certain degree of intergradation between the two species (see table 5). There is also a decided divergence in the number of caudal segments, but the intergradation in that character is even more pronounced than in the number of dorsal rays.

The individuals comprising the species *regulus* seem, from the material examined, to form a comparatively homogeneous and compact mass with reference to their structure, shown especially by the relative stability in the number of trunk segments and the almost constantly quadrangular first caudal segment. Of the 24 specimens examined only one from Campeche has nine trunk segments, and only one from Cat Island has an incompletely hexangular first caudal segment. The specimens from Campeche otherwise differ but slightly from those of the northern coast of the Gulf. The frequency distributions of the fin rays in the Campeche lot correspond exactly to

FIGURE 70.—*Hippocampus regulus*, drawn from the type, a male 30.5 mm long from Harbor Island, Tex.; U.S.N.M. no. 92950. Length of specimen as drawn, 19.5 mm.

those from Mississippi and Texas. The number of caudal segments is also nearly the same, averaging slightly greater in the Campeche lot, but this slight difference may disappear when more specimens

FIGURE 71.—*Hippocampus regulus*, drawn from a female 29.5 mm long from Harbor Island, Tex. Length of specimen as drawn, 17.5 mm.

are examined. The presence of these two variants in a widely separated population emphasizes the relative homogeneity of *regulus* and is in strong contrast to the high degree of variability shown by

zosterae, which tends to break up into distinct stocks as discussed hereafter (p. 592).

Of the two variants of *regulus*, the one with the nine trunk segments has a quadrangular first caudal, while the one with an incompletely hexangular first caudal segment has 10 trunk segments. It will be shown (p. 591) that in *zosterae* nine trunk segments are always correlated with a hexangular first caudal segment. In *regulus* these variations are not only infrequent but when they do occur they are not correlated. Another point of considerable interest is that *regulus*, in two important characters—number of trunk segments and number of pectoral rays—approaches much more the Key West population of *zosterae* than its Pensacola population (see table 5).

There are legitimate grounds for difference of opinion in regard to the taxonomic status of *regulus*, whether it is to be considered as a full species or as a subspecies. According to the data presented, it may be regarded, within reason, as a subspecies of *zosterae*. However, while the degree of intergradation in the characters investigated is greater than usual between distinct species of fishes in general, it is also of a lesser degree than the usual intergradation between subspecies of fishes. Furthermore, speciation in the genus *Hippocampus* is quite unlike that usual among fishes. A condition of very near approach or even of overlapping is evidently normal in *Hippocampus* (see, for instance, discussion of relationship of *ingens*, p. 536). A comparison between tables 1 and 5 shows that the divergence between *regulus* and *zosterae*, in the number of dorsal rays and caudal segments, is much more pronounced and of a much higher degree than that between the subspecies *hudsonius* and *punctulatus*, for instance. It was also shown that *regulus* is nearer to the Key West population of *zosterae*, whereas if *regulus* were a mere geographical subspecies of *zosterae*, it would be reasonable to expect it to differ in a regular latitudinal direction and to be nearer the Pensacola population of *zosterae*. All available evidence considered, therefore, it seems best to assign full specific rank to *regulus*, although this opinion may have to be changed by a study of more material and specimens from intermediate localities.

As compared with all other American species of *Hippocampus* except *zosterae*, *regulus* is readily distinguished by the number of trunk and caudal segments, the number of fin rays, and its small size.

Material studied and geographic distribution.—Cat Island, Miss., collected by the author November 15, 1931. Harbor Island, Tex., J. C. Pearson (92950, the type, May 1927; also in the Bureau of Fisheries, collected on the following dates: 1 specimen with the type; 2 on April 3, 1927, 1 on October 20, 1926, 2 on October 25, 1926, 2 on November 12, 1926). Hog Island, Tex.; J. C. Pearson. Champoton,

Campeche, Mexico, A. S. Pearse; July 13, 1932 (Univ. Michigan Mus. no. 102819).

Total number of specimens studied, 24; 13, with a broad pouch or at least a rudiment of one, 21 to 34 mm long; 11, without any trace of a brood pouch, 17 to 30 mm long. Some of the larger specimens have the brood pouch fully developed. Judged by the material examined, the maximum size attained by *regulus* is considerably below that of *zosterae*. All the specimens I obtained at Cat Island were picked out from seaweed landed by a small drag seine in shallow water on a sandy shore.

TABLE 5.—*Frequency distribution of some meristic characters of* Hippocampus zosterae *and* regulus *according to locality*

Species and locality	Dorsal rays					Caudal segments							Trunk segments [3]			Pectoral rays		
	10	11	12	13	14	28	29	30	31	32	33	34	9	10	11	10	11	12
zosterae:																		
Biscayne Bay	---	---	2	---	---	---	---	---	1	---	2	2	2	3	---	---	1	1
Key West [1]	---	4	11	5	---	---	---	---	4	11	4	1	4	16	1	---	12	9
Captiva Pass	---	---	16	2	---	---	---	1	2	7	6	1	5	12	1	3	6	9
Pensacola [2]	---	2	9	---	1	---	---	---	2	6	4	---	7	6	---	1	4	8
regulus:																		
Mississippi and Texas	2	15	1	---	---	1	6	6	4	2	---	---	---	19	---	4	12	2
Campeche, Mexico	---	5	---	---	---	---	---	2	2	1	---	---	1	4	---	1	4	---

[1] Including four specimens from Newfound Harbor Key.

[2] Including one specimen from Apalachicola.

[3] Two specimens from Captiva Pass and two from Pensacola had 10 incomplete trunk segments and are included with the others having 10 segments.

HIPPOCAMPUS ZOSTERAE Jordan and Gilbert

Hippocampus zosterae JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 5, p. 265, 1882 (Laguna Grande, Pensacola, Fla.)

Hippocampus zosterae BEAN, U. S. Nat. Mus. Bull. 27, p. 430, 1883 (Pensacola, Fla.).

Hippocampus rosamondae BORODIN, Bull. Vanderbilt Oceanogr. Mus., vol. 1, art. 1, p. 16, pl. 1, fig. 3, 1928 (Cuba).

Diagnosis.—First caudal segment usually quadrangular, very often hexangular; last trunk segment usually octangular, often hexangular (when last trunk segment is hexangular the first caudal in the same specimen is also usually hexangular); penultimate trunk segment nearly always septangular (incompletely novemangular in two out of 59 specimens examined). In other words, usually only one extra plate for the support of the dorsal, in most cases on the last trunk segment, often on the first caudal segment, infrequently two extra plates (on one side only of the two specimens noted); or, upper ridges of trunk and tail overlapping on one segment, infrequently on two, rarely on none (in one out of 59 examined, this specimen being without extra plates). (The variation in the structure of the first caudal

segment is closely correlated with the variation in the structure of the last trunk segment and the number of trunk segments. The frequency of occurrence of these variations differs with the local stock. These points are discussed below.) Trunk segments usually 10, often 9, sometimes 11. Caudal segments usually 31 to 33, varying 30 to 34. Dorsal rays modally 12, varying 11 to 14. Pectoral rays 10 to 12. Tubercles usually quite conspicuous, often becoming very low in full-grown males. Coronet comparatively high. Trunk rather deep; snout usually quite short. Presence of filaments varying with the individual and evidently also with age, oftener absent, the specimens having filaments usually belonging to the smaller size groups, filaments when present relatively short, often branched. Color variously mottled with contrasting yellowish shades, often with white and brown, without any definite color pattern, sometimes quite dark all over, sometimes with whitish cross bands on tail; dorsal with a submarginal brown streak typically present, usually with one or two rows of diffuse spots at the base; often entire fin nearly colorless. (See table 5 for counts.)

Variability in structure of region where trunk and tail meet, and its correlation.—*H. zosterae* shows two main trends of variation which are correlated with locality to a considerable extent. In the majority of specimens of the entire available lot representing all localities, the first caudal segment is quadrangular and the last trunk segment octangular. All such specimens have the single extra plate on the last trunk segment, while the dorsal is situated on the last two trunk segments and the number of trunk segments is 10, infrequently 11. Very often the following important variation in structure occurs: The first caudal segment is hexangular, and the last trunk segment is also hexangular; in other words, the extra plate is on the first caudal instead of on the last trunk segment. In all such specimens the base of the dorsal is situated over the last trunk and first caudal instead of over the last two trunk segments, and the number of trunk segments is 9 instead of 10.

This latter variation may be easily conceived as having been derived from the former by the last trunk segment losing the last lowermost point of intersection and thus having changed to a caudal segment. The probability that this is the correct explanation is increased by the fact that in *regulus*, the near relative of *zosterae*, the former condition is normal for the species almost without any exception. Furthermore, four specimens of *zosterae* out of 59 examined are asymmetrical, one side of the fish showing one of the two general variations described and the other side showing the other variation, the probable manner in which the change occurs thus being shown by the same individual fish (see p. 592). In other words, in *zosterae* there is a very decided

tendency for the last trunk segment to change to a caudal segment by the loss of the last point of intersection on the lower lateral ridge. As a result the number of trunk segments is reduced by one; the first caudal, instead of the last trunk segment, now bears the extra plate for the support of the dorsal, and the base of the dorsal is placed over the last trunk and first caudal segments instead of over the last two trunk segments. This important trend of evolution shown by a comparatively large percentage of specimens evidently indicates a more recent development. The frequent presence of a hexangular caudal segment in this species may appear to show a more primitive condition, since this occurs also in the subgenus *Hippocampus*. However, in *zosterae* a hexangular caudal segment is correlated with a hexangular last trunk segment, and the latter condition, in its turn, is unique and apparently represents a more recent development. Consequently, the hexangular first caudal segment in *zosterae* probably represents a pseudoreversion and not a primitive condition; that is, it is caused by the last trunk segment changing to a caudal segment as a consequence of a shortening of the lower ridge on the trunk. The evidence strongly favors the conclusion that *zosterae* is now undergoing a gradual change, which, if carried far enough, will result in the formation of a distinct species, or even subgenus, having nine trunk segments. The tempo of the change evidently differs with the population (see p. 592).

For convenience, the individual variability, besides the main trends of variation, may be indicated as follows: Altogether 59 specimens were examined, in which the number of trunk segments were: 19 with 9 complete segments; 34 with 10 complete segments; 4 with 10 incomplete segments; and 2 with 11 complete segments. Of those having 9 segments 14 have an extra plate on the first caudal segment only; three have an extra plate on the last trunk and first caudal segments; in one an extra plate is present only on one side of the first caudal segment; and in one an extra plate is present only on one side of the last trunk segment and on both sides of the first caudal segment. Counting the variants showing asymmetry as though they were bilaterally symmetrical, and combining the above figures, we get 15 specimens having an extra plate on the first caudal segment only and four having extra plates on the last trunk and first caudal segments. These figures consequently show that nine trunk segments are always correlated with a hexangular first caudal segment and decidedly correlated with a hexangular last trunk segment. Of the 34 specimens having 10 trunk segments, 30 have an extra plate on the last trunk segment only; one has an extra plate on one side of the penultimate trunk segment on both sides of the last trunk segment and none on the first caudal; one has an extra plate on one side only of the last trunk segment and on both sides of the first caudal

segment; one has an extra plate on both sides of the last trunk and first caudal segments; one lacks extra plates (this being the only one of all the specimens examined, including all the species, which entirely lacked extra plates for the support of the dorsal). Again combining the specimens showing asymmetry with the others, as above, omitting the specimens entirely lacking plates, and not taking account of the extra plate on the penultimate trunk segment of one specimen, we get 31 specimens having an extra plate on the last trunk segment only and two having extra plates on the last trunk and first caudal segments. Consequently, these figures show that 10 trunk segments are nearly always correlated with an octangular last trunk segment and nearly always with a quadrangular first caudal segment.

The two specimens with 11 trunk segments have an extra plate on the last trunk segment only, like the dominant condition in those specimens having 10 trunk segments.

Four specimens, two from Pensacola and two from Captiva Pass, have 10 trunk segments with the last one incomplete (see p. 504 for explanation of an incomplete trunk segment). Each one of these four has the extra plate on both sides of the tenth or last incomplete segment, one also having an extra plate on one side of the penultimate segment. If each side is considered separately in these four asymmetrical specimens, one side will have nine trunk segments and the extra plate on the first caudal segment, while the other side will be found to have 10 trunk segments with the extra plate on the last trunk and none on the first caudal. The two chief trends of variation in *zosterae* are thus indicated on either side of each one of these four variants, the last trunk segment having had the lower lateral ridge shortened on one side only, the last trunk segment thus having changed to a caudal segment on that side.

Population divergence.—The relative frequency of occurrence of the two chief variations as described in the preceding paragraphs differs markedly with locality and may be used in racial or varietal distinction as follows (for the sake of brevity these differences may be indicated by reference to the number of trunk segments, but the other correlated differences also occur as described):

By reference to table 5, it will be noted that nine trunk segments are possibly the dominant condition at Pensacola, although the number of specimens studied is not sufficient to be certain. Anyway, the percentage of such specimens must be high. In the Captiva Pass lot a little less than a third of the specimens have nine trunk segments, while in the Key West population a little less than a fifth have nine trunk segments. Among the specimens enumerated as having 10 trunk segments in table 5, two from Pensacola and two from Captiva Pass have the last segment incomplete and may be counted as having

nine segments on one side. Consequently, the decided or predominant tendency shown by the more northern populations of having one segment less than the population from Key West is actually more pronounced than indicated by the figures in table 5. Besides the decided difference in the number of trunk segments, table 5 also shows a less decided but apparently significant difference in the frequency distributions of the number of pectoral rays. While the number of specimens studied is too small for a thoroughgoing racial analysis, it seems evident that *zosterae* tends to break up into distinct stocks in spite of its comparatively restricted geographic range.

Distinctive characters and relationships.—*H. zosterae* may be distinguished easily from its congener occurring in its range, *punctulatus*, by the smaller number of fin rays and trunk segments and its much smaller size. The number of caudal segments is also generally less, but there is a small degree of intergradation in this character. This species is closely related to *regulus* and the difference between them has been discussed (p. 585).

Material examined and geographic distribution.—All localities on the coast of Florida, as follows: Cape Florida (67658, three dried specimens). Biscayne Bay at Bonefish Banks, November 27, 1906 (57236). Newfound Harbor Key, Pine and Bean, December 7, 1906 (57453). Key West (92717, April 15–27, 1884, *Albatross*, 1 specimen; also 15 specimens collected on seven different dates by the staff of the Bureau of Fisheries Biological Station). Boca Chica, April 11, 1922. Captiva Pass; O. P. Hay (Field Mus. Nat. Hist. no. 2131). St. Martins; January 17, 1902; *Fish Hawk* (73242). Pepperfish Key; November 21, 1901; *Fish Hawk* (73241). Apalachicola Bay; S. Stearns; 1880 (26595, this specimen found inseparably mixed in same bottle with 30753). Pensacola; S. Stearns (30753, mixed with the preceding specimen as noted; also 31920).

Total number of specimens examined, 59; 29, with a brood pouch or at least a rudiment of one, 25 to 44 mm long; 30, with no trace of a brood pouch, 24 to 44 mm long. Biscayne Bay to Pensacola, therefore, must be regarded now as representing the geographic range of this species, and unquestioned records from other places that may be referred to the present species are not known to me. The reference of *rosamondae*, from Cuba, to the synonymy of *zosterae*, as noted in the next paragraph, must remain in doubt until the type is reexamined and compared with authentic specimens of *zosterae*.

Synonymy.—In the description of *H. rosamondae*, Borodin states that it differs from *zosterae* " * * * by having longer dorsal, longer snout and very scarce and small filaments on the head and by the absence of body's spines." The dorsal in *rosamondae* (14 rays)

has more rays than usual for *zosterae*, but it falls within its range of variation (see table 5). The number of filaments in *zosterae* as well as all other species of *Hippocampus* depends on individual variability (see p. 511). The spines as shown on the figure are not strikingly different from those in *zosterae*. Besides the relative development of spines differs markedly with age and sex. That leaves only the longer snout to be considered. The figure of *rosamondae* does show the snout longer and the eye smaller than usual in *zosterae*, but there is considerable individual variability in that respect, and in females it is usually somewhat longer than in the males. Some of the specimens of *zosterae* examined have the snout nearly as long as in the figure of *rosamondae*. On the basis of the available evidence, therefore, it seems that *rosamondae* was based on a specimen of *zosterae*. At any rate, the allegedly specific differences given in the original description fall within the range of variation of *zosterae*.

U. S. GOVERNMENT PRINTING OFFICE: 1936